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(12) **United States Patent**
Smith

(10) **Patent No.: US 12,116,841 B2**
(45) **Date of Patent: *Oct. 15, 2024**

(54) **OPERATING SYSTEM FOR A COVERING FOR AN ARCHITECTURAL OPENING**

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(72) Inventor: **Stephen P. Smith**, Denver, CO (US)

(73) Assignee: **Hunter Douglas Inc.**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **18/173,294**

(22) Filed: **Feb. 23, 2023**

(65) **Prior Publication Data**

US 2023/0203884 A1 Jun. 29, 2023

Related U.S. Application Data

(63) Continuation of application No. 16/987,471, filed on Aug. 7, 2020, now Pat. No. 11,643,872, which is a (Continued)

(51) **Int. Cl.**
E06B 9/72 (2006.01)
E06B 9/26 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***E06B 9/72*** (2013.01); ***E06B 9/26*** (2013.01); ***E06B 9/322*** (2013.01); ***E06B 9/34*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC ... E06B 9/26; E06B 9/322; E06B 9/34; E06B 9/50; E06B 9/62; E06B 2009/2435; E06B 9/72; E06B 9/74
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,118,033 A 11/1914 McCloud
1,325,105 A 12/1919 Minnis
(Continued)

FOREIGN PATENT DOCUMENTS

JP 58-69695 U 5/1983
TW M430224 U1 6/2012

OTHER PUBLICATIONS

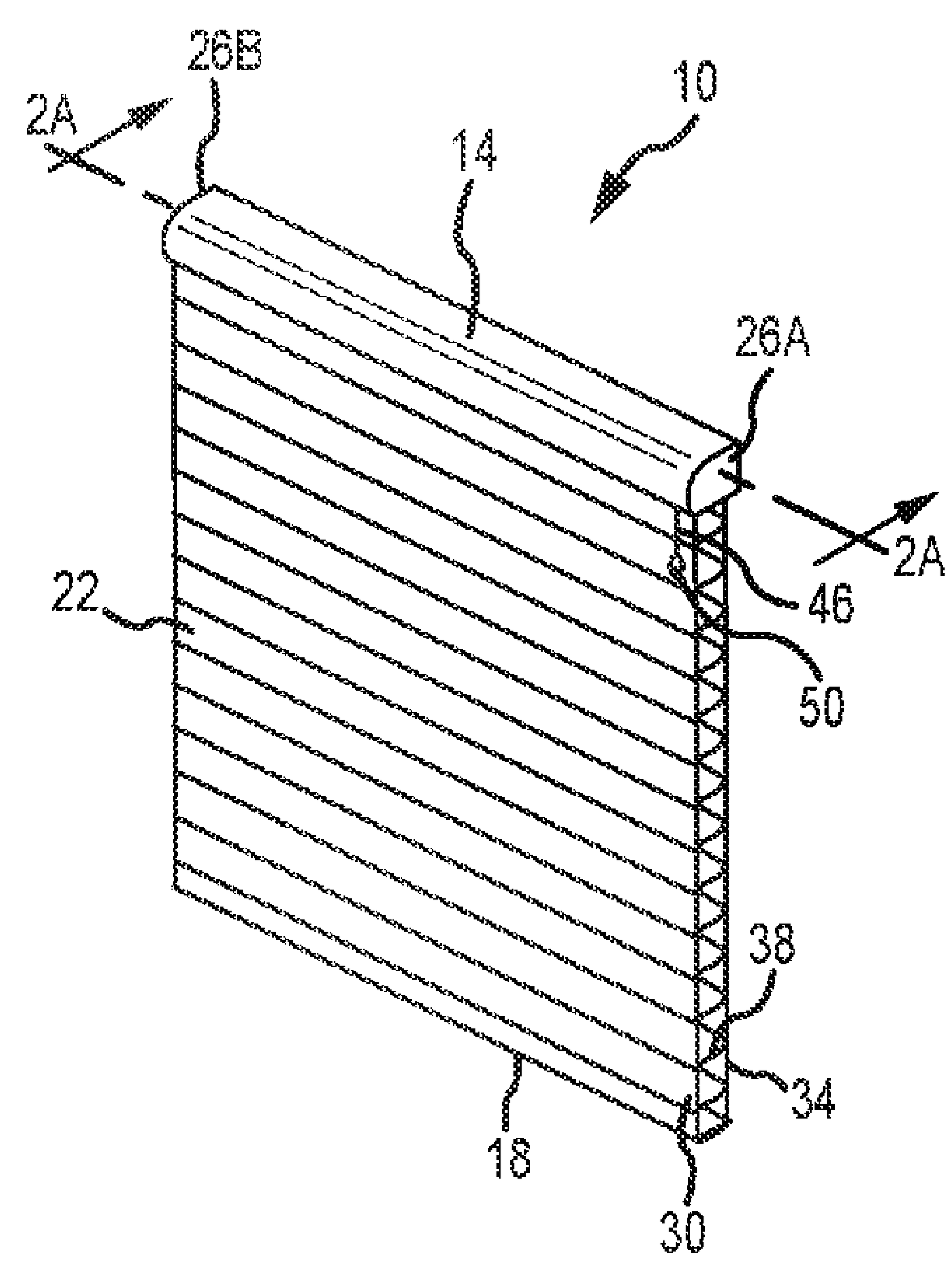
PCT International Search Report and Written Opinion for International application No. PCT/US2013/030176 dated May 10, 2013.
(Continued)

Primary Examiner — Abe Massad
(74) *Attorney, Agent, or Firm* — KDW Firm PLLC

(57) **ABSTRACT**

A covering for an architectural opening is provided. The covering may include a roller rotatable about a longitudinal axis, a shade associated with the roller, and an operating system operably associated with the roller. The operating system may include a base, a drive mechanism, a transmission, an actuator arm, and an engagement arm. The drive mechanism may be associated with the base to provide an input torque. The transmission may be associated with the drive mechanism to selectively transmit the input torque to the roller. The actuator arm may be associated with the base to indirectly set a rotation direction of the roller. The engagement arm may be associated with the base and engageable with the transmission.

16 Claims, 30 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/856,121, filed on Dec. 28, 2017, now Pat. No. 10,774,586, which is a continuation of application No. 14/766,043, filed as application No. PCT/US2013/030176 on Mar. 11, 2013, now Pat. No. 9,890,588.

(51) **Int. Cl.**

E06B 9/322	(2006.01)
E06B 9/34	(2006.01)
E06B 9/50	(2006.01)
E06B 9/62	(2006.01)
E06B 9/74	(2006.01)
E06B 9/24	(2006.01)

(52) **U.S. Cl.**

CPC ***E06B 9/50*** (2013.01); ***E06B 9/62*** (2013.01); ***E06B 9/74*** (2013.01); *E06B 2009/2435* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,568,203	A	1/1926	Bernard	
6,129,131	A	10/2000	Colson	
6,201,364	B1	3/2001	Will et al.	
6,223,802	B1	5/2001	Colson	
7,128,126	B2	10/2006	Smith et al.	
7,159,635	B2	1/2007	Holt et al.	
7,228,797	B1	6/2007	Hillman et al.	
7,578,334	B2	8/2009	Smith et al.	
8,186,413	B2	5/2012	Fujita et al.	
8,851,143	B2	10/2014	Zhu	
9,187,951	B2 *	11/2015	Yu	E06B 9/90
9,890,588	B2	2/2018	Smith	
10,451,145	B2	10/2019	Chen et al.	
11,136,821	B2	10/2021	Smith et al.	
11,486,198	B2	11/2022	Anthony et al.	
11,643,872	B2 *	5/2023	Smith	E06B 9/50 160/311
2004/0226663	A1	11/2004	Smith et al.	
2006/0118248	A1	6/2006	Anderson et al.	
2006/0272783	A1	12/2006	Smith et al.	
2008/0202709	A1	8/2008	Anderson et al.	
2009/0120593	A1	5/2009	Lesperance	
2010/0018656	A1 *	1/2010	Fujita	E06B 9/32 160/319
2013/0025805	A1	1/2013	Lin	
2013/0220561	A1	8/2013	Yu et al.	
2014/0216668	A1 *	8/2014	Kim	E06B 9/42 160/322
2015/0007946	A1	1/2015	Yu et al.	
2015/0368968	A1	12/2015	Smith	

OTHER PUBLICATIONS

IPRP of International application No. PCT/US2013/030176 dated Mar. 25, 2015.

Third Party Submission under 37 CFR 1.290 filed on Dec. 12, 2019.

* cited by examiner

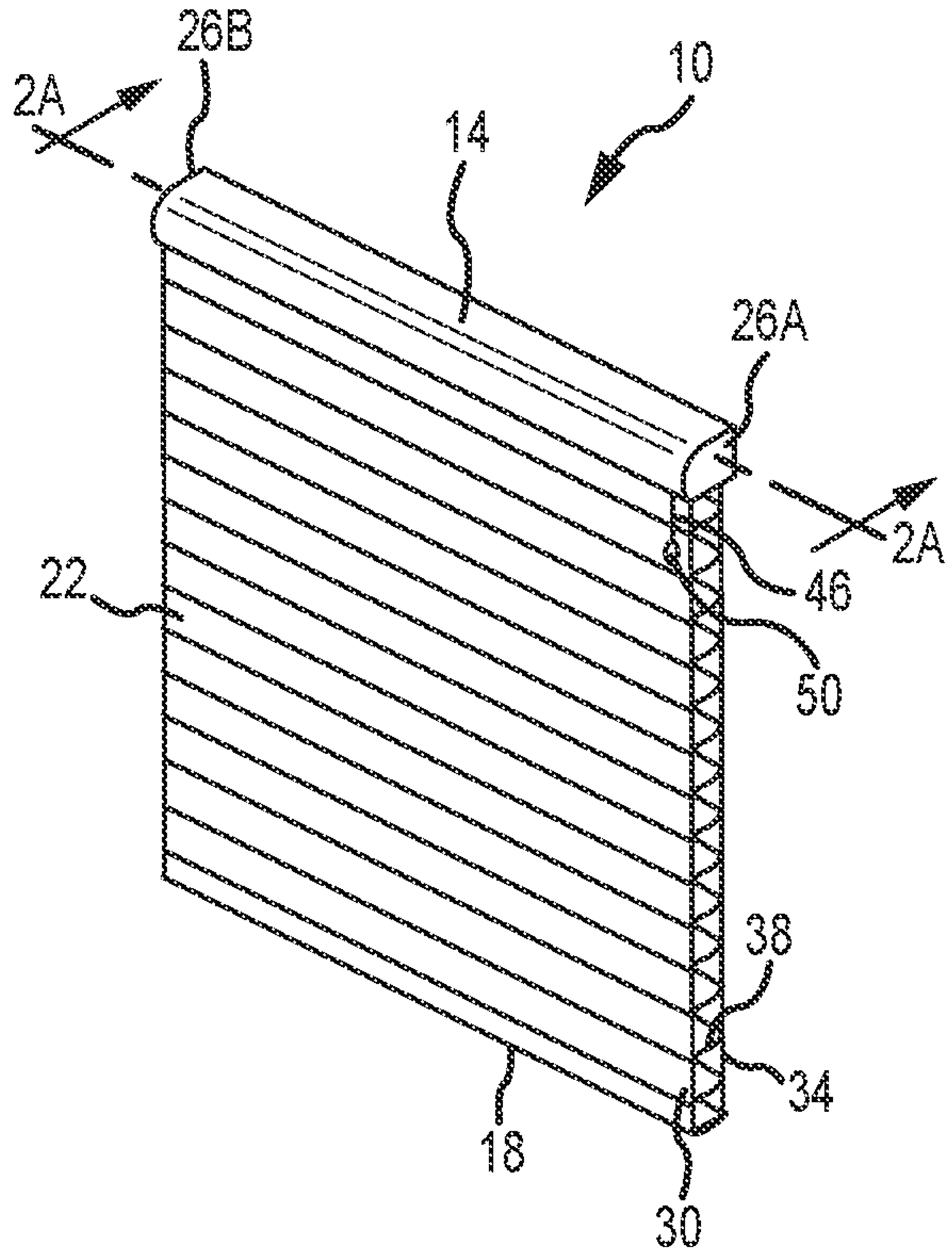


FIG.1A

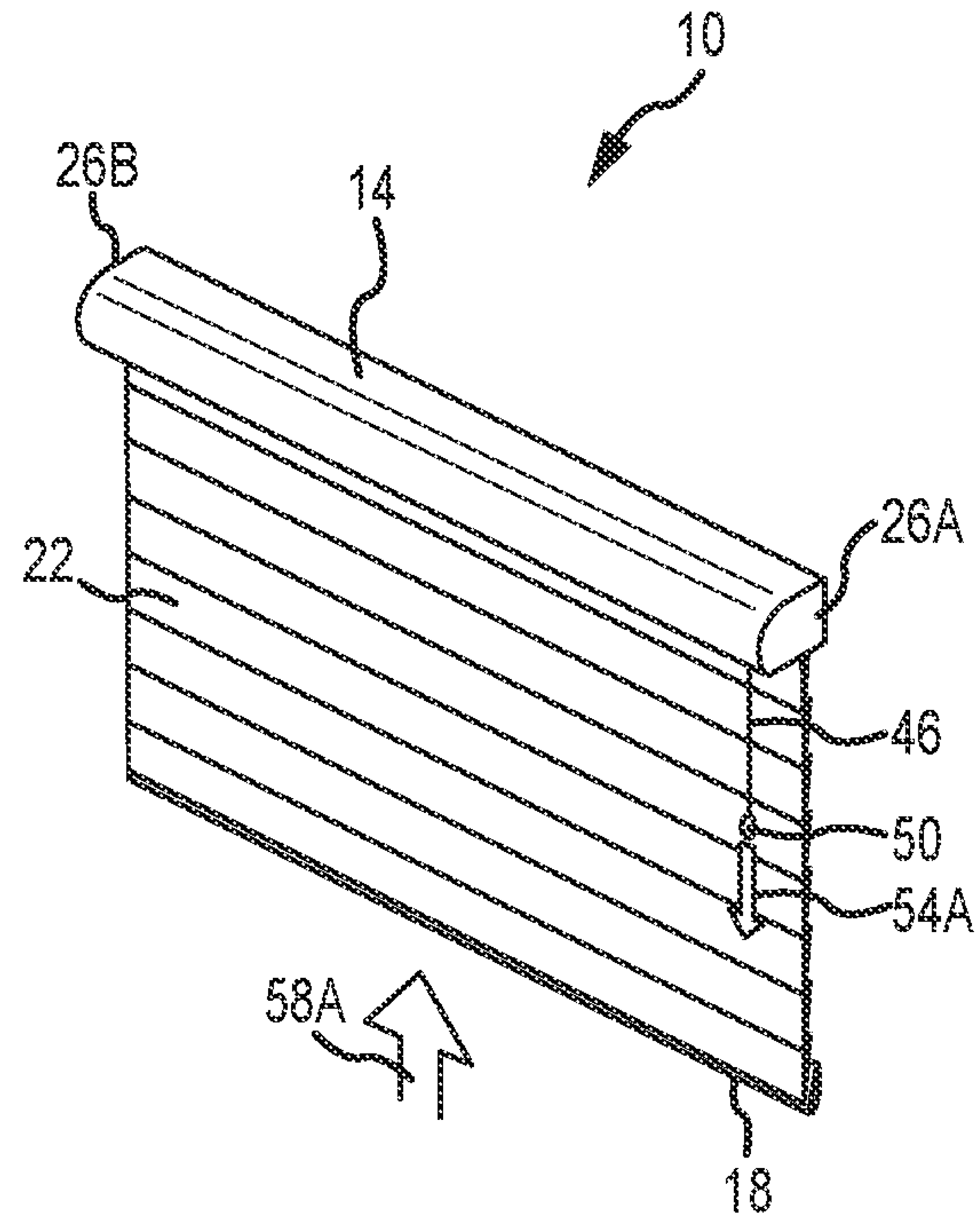


FIG.1B

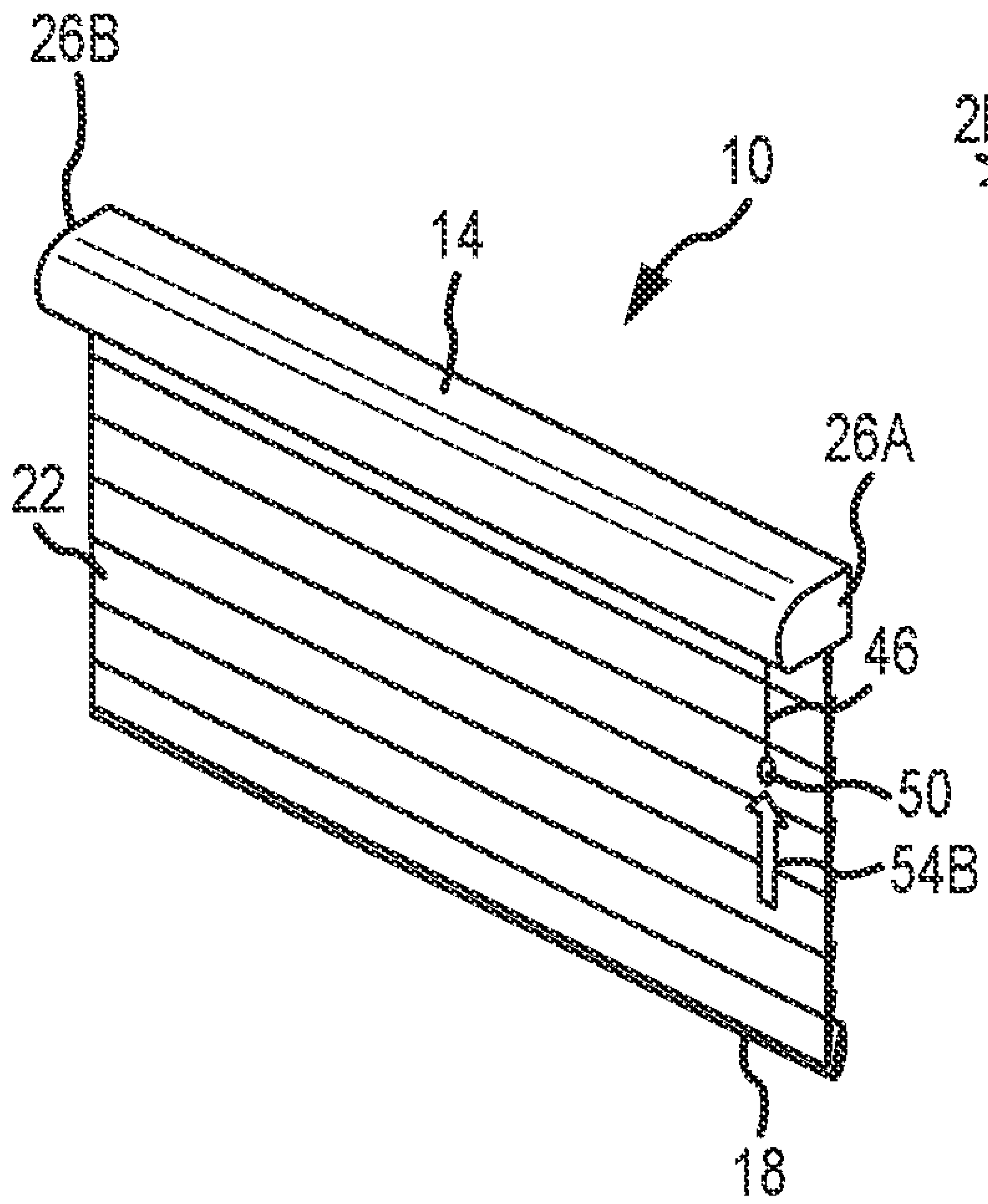
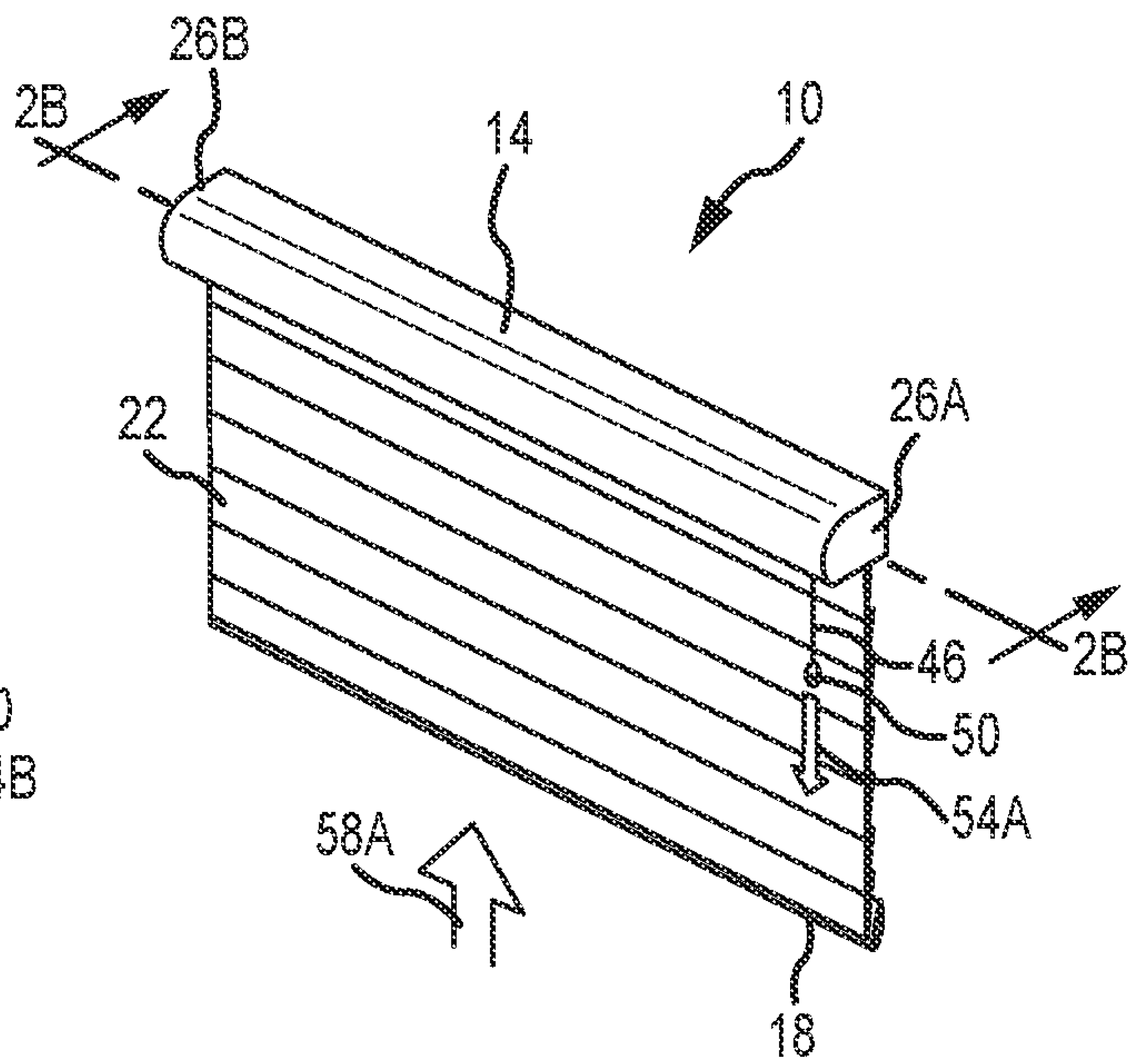


FIG.1C



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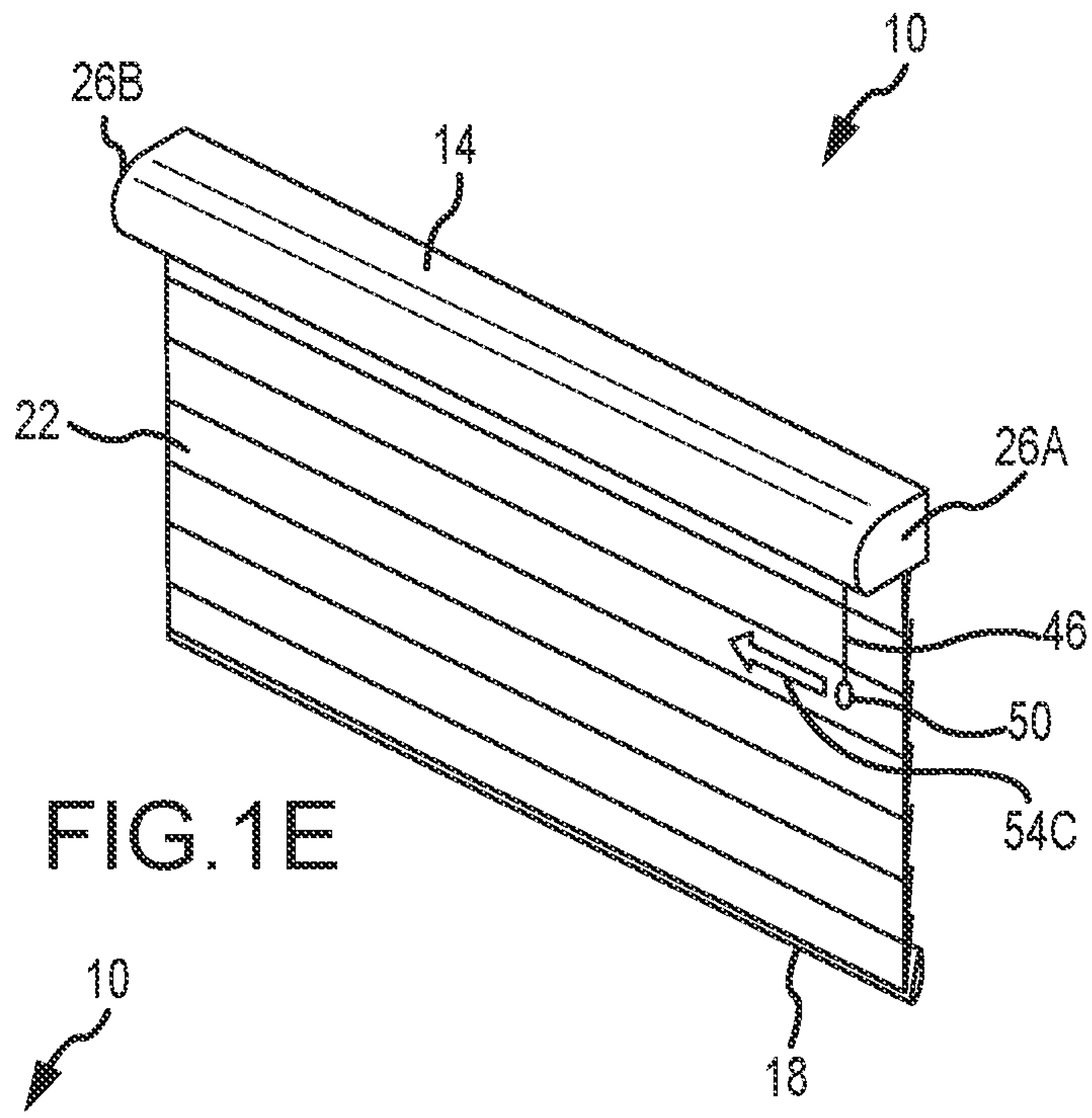

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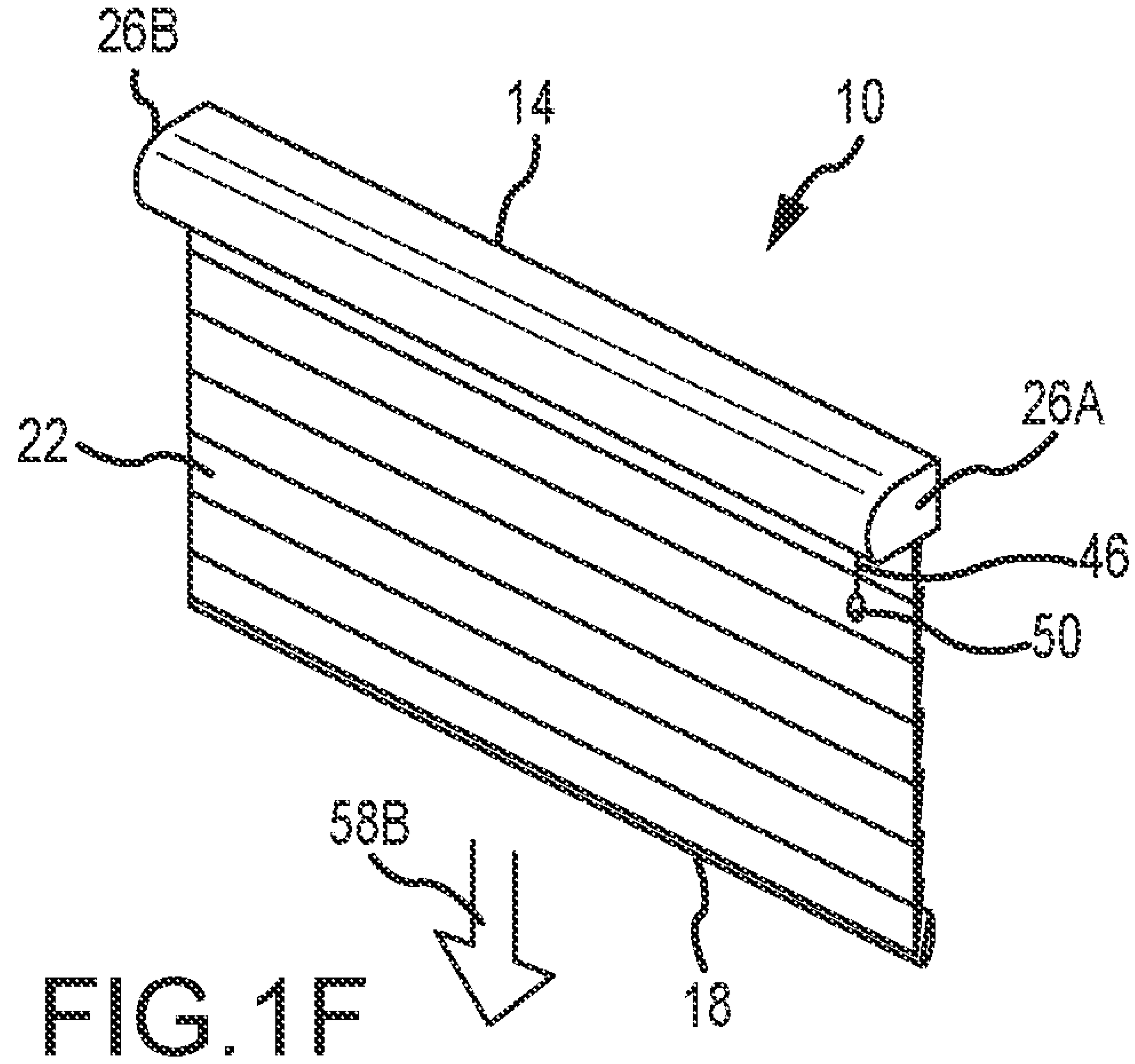

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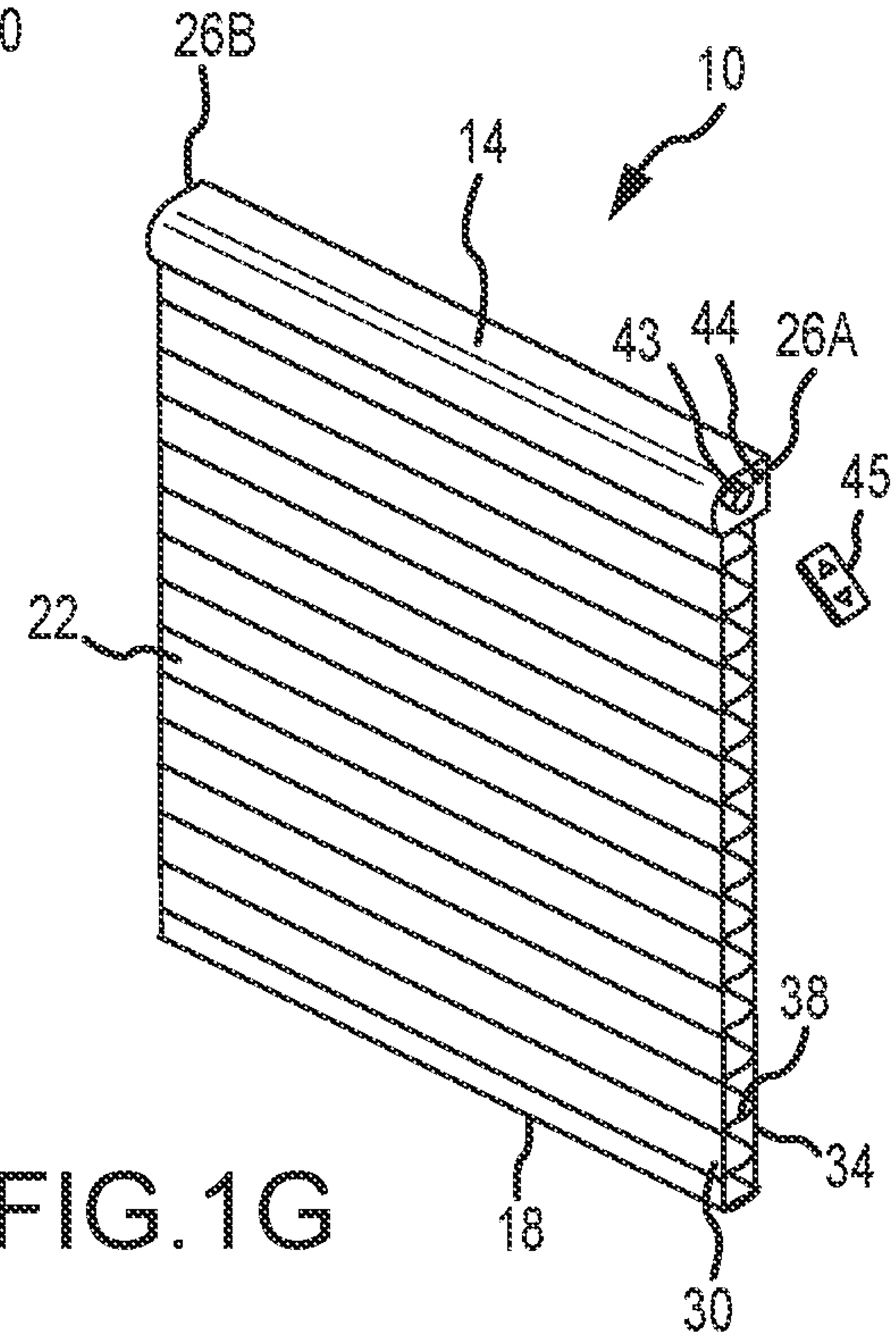

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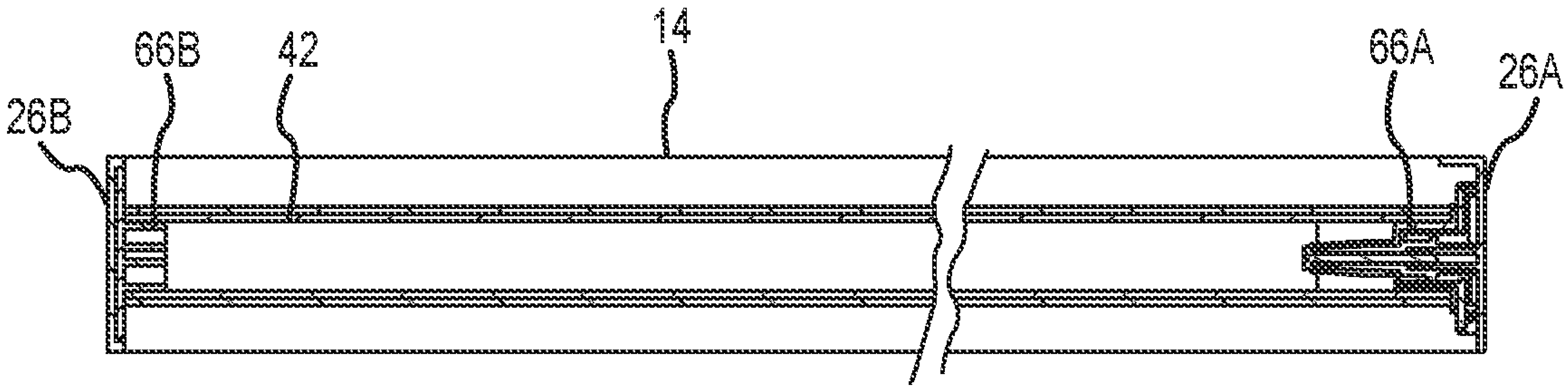
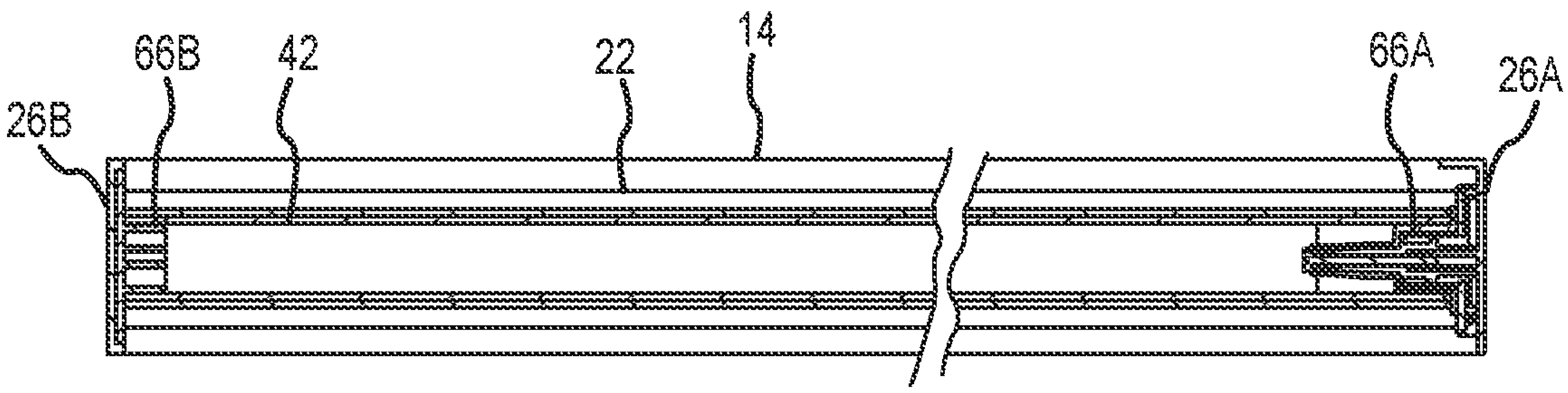


FIG.2A



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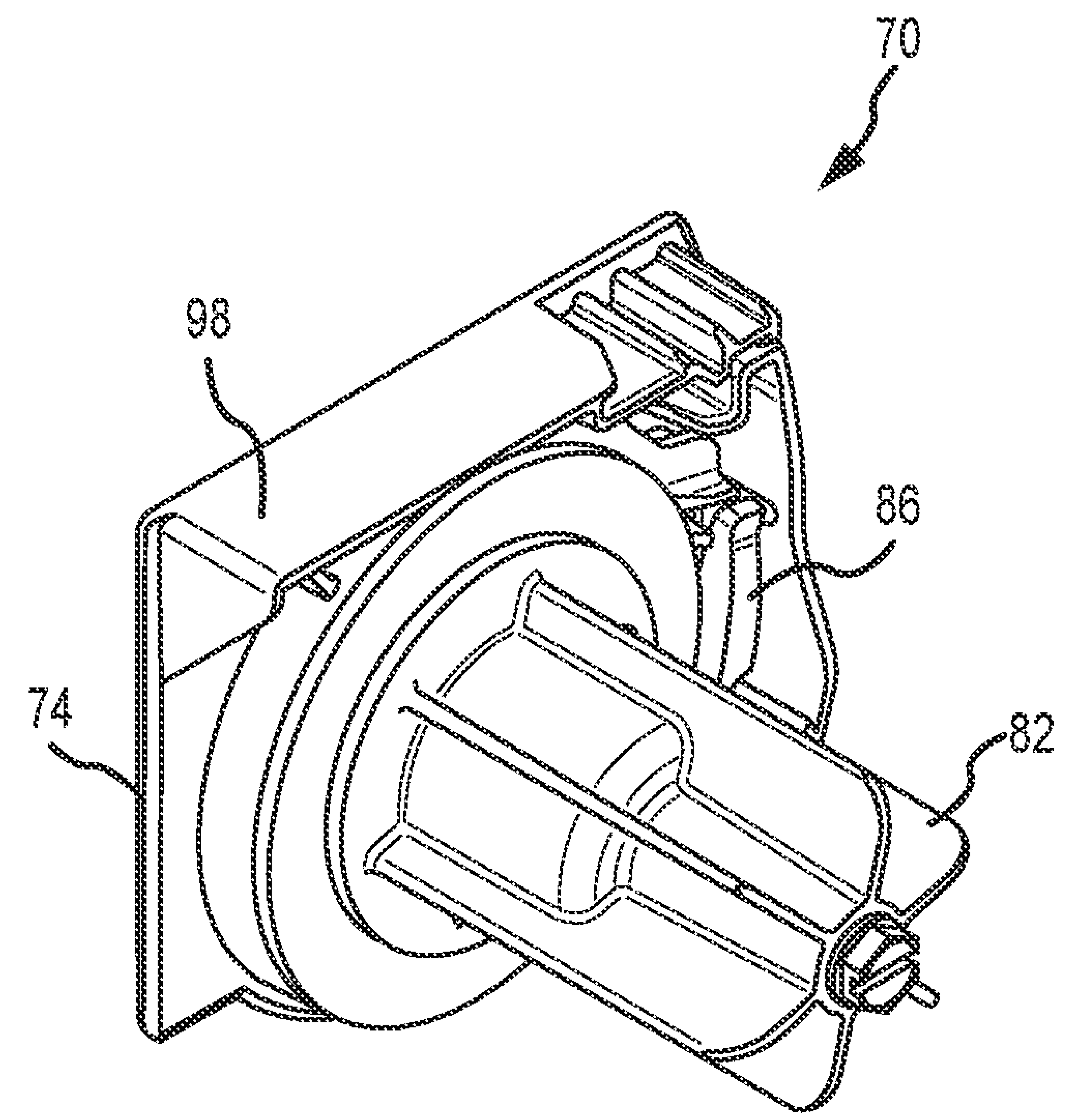
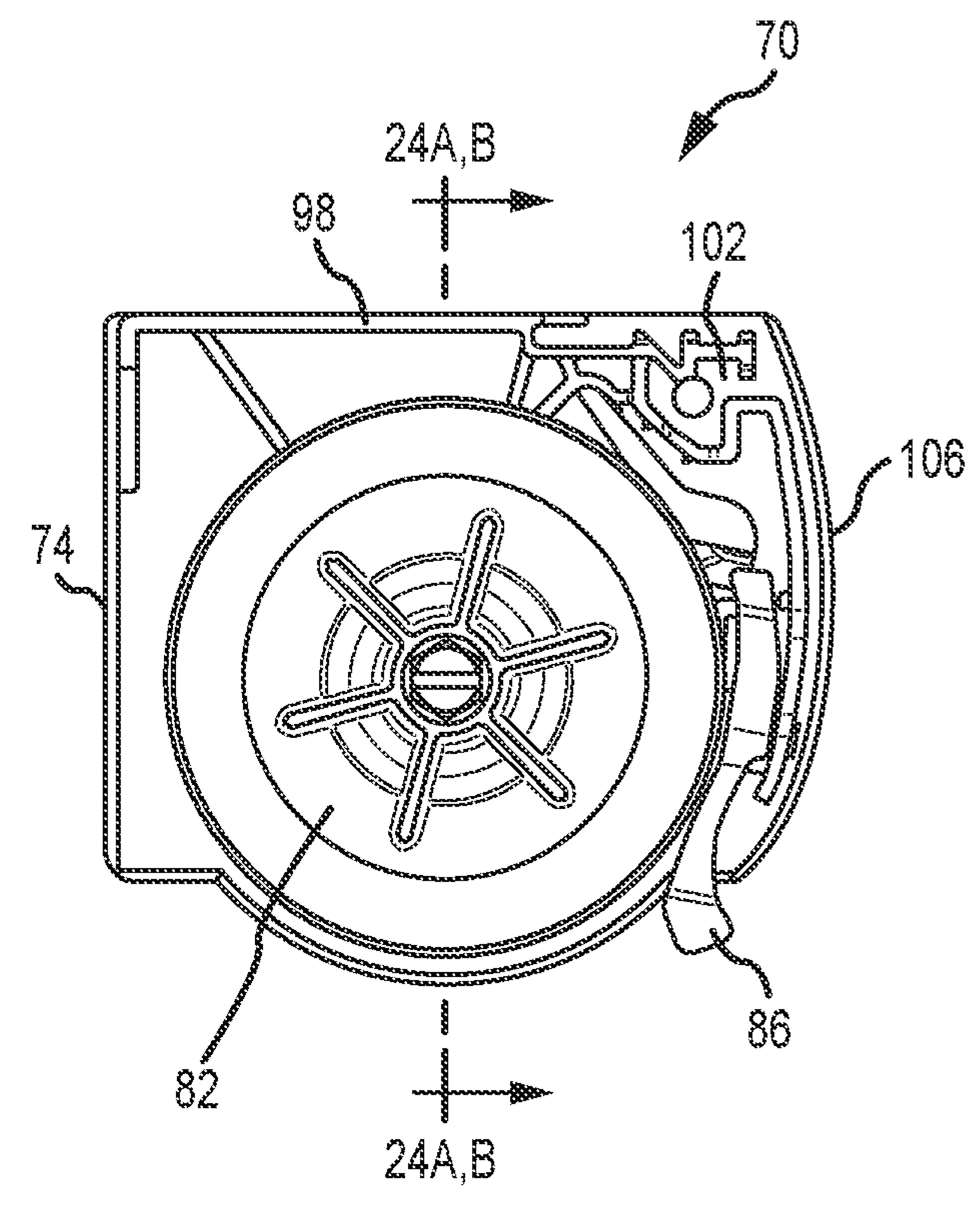


FIG.3A



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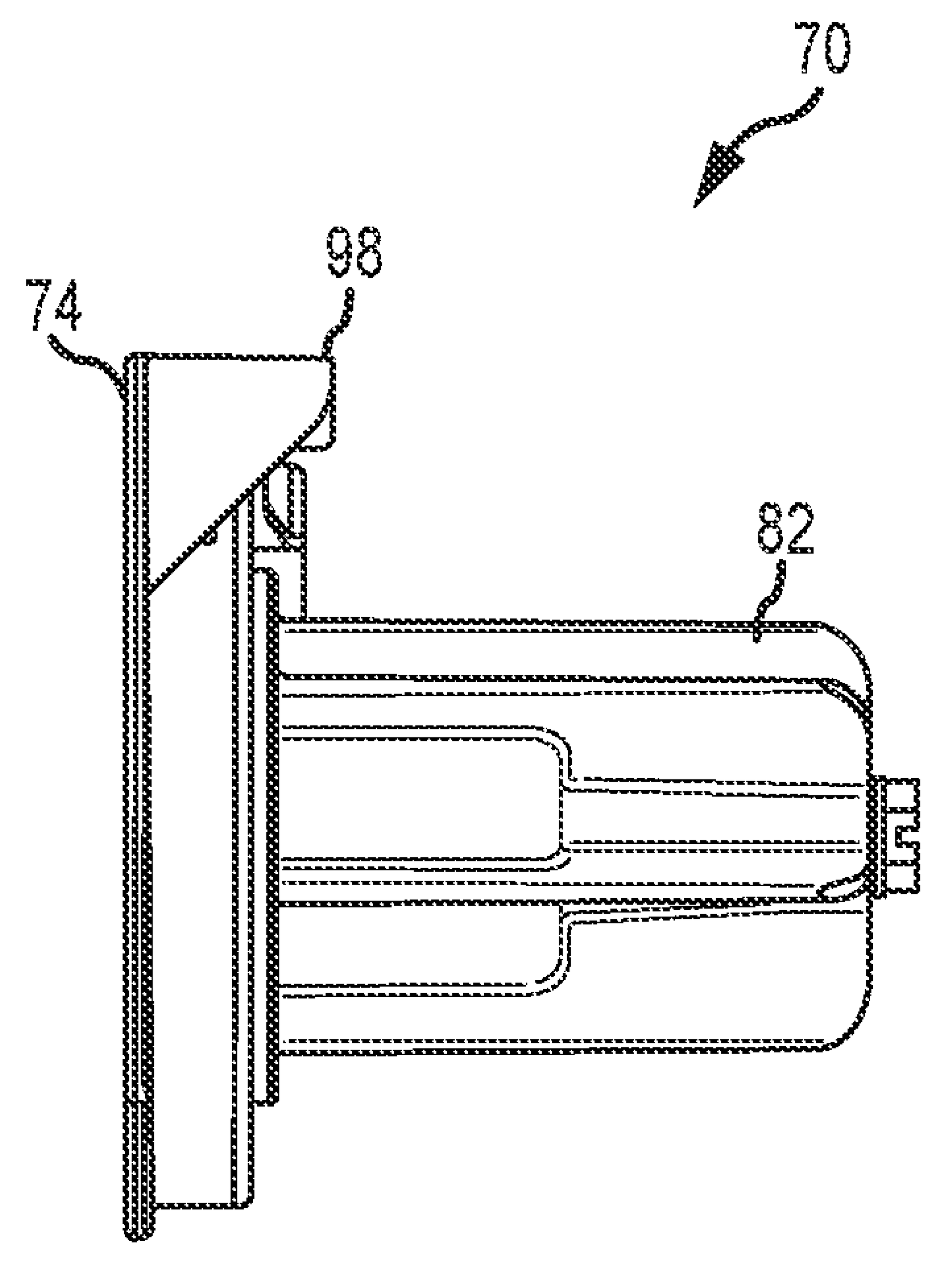

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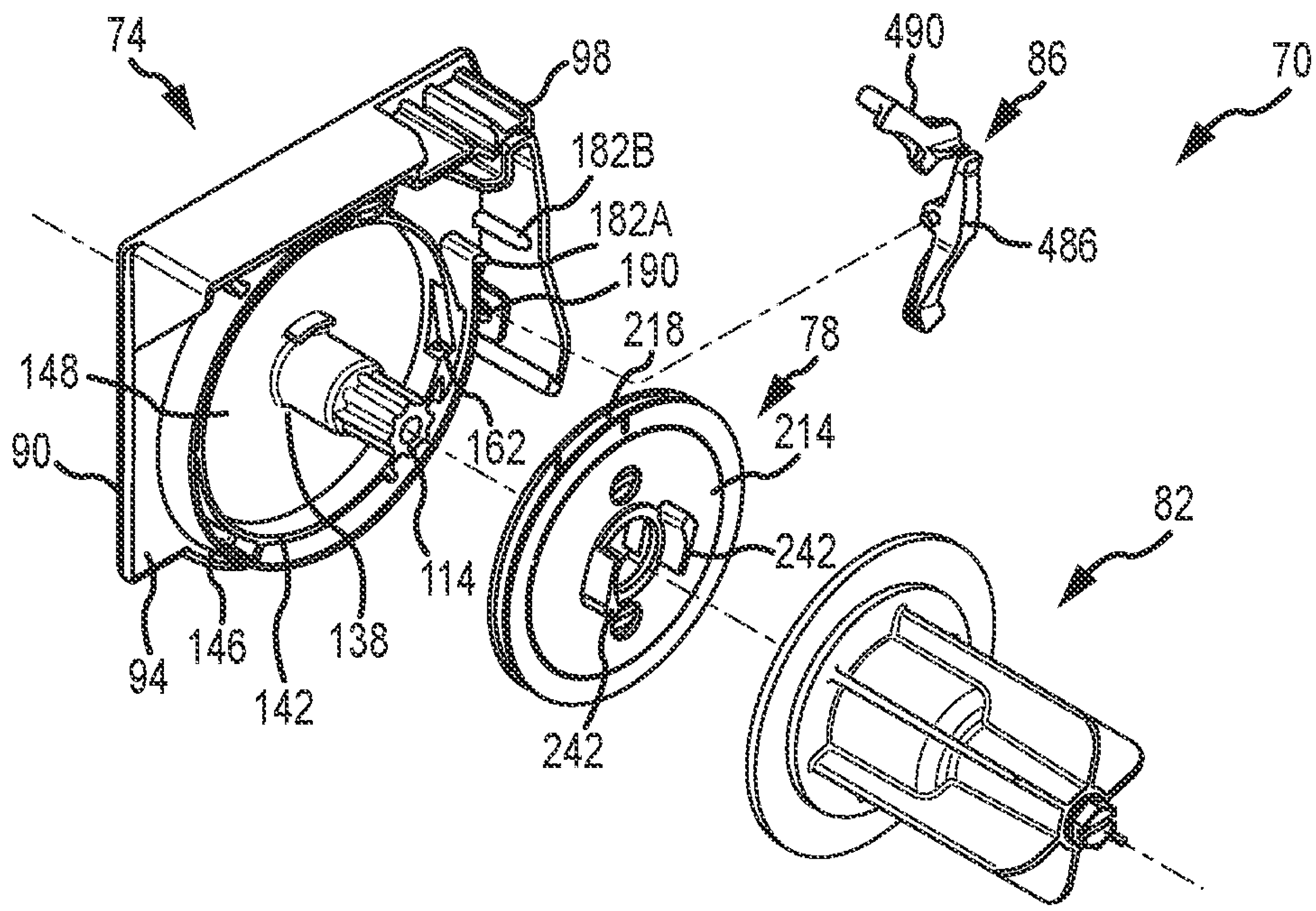
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FIG.4A

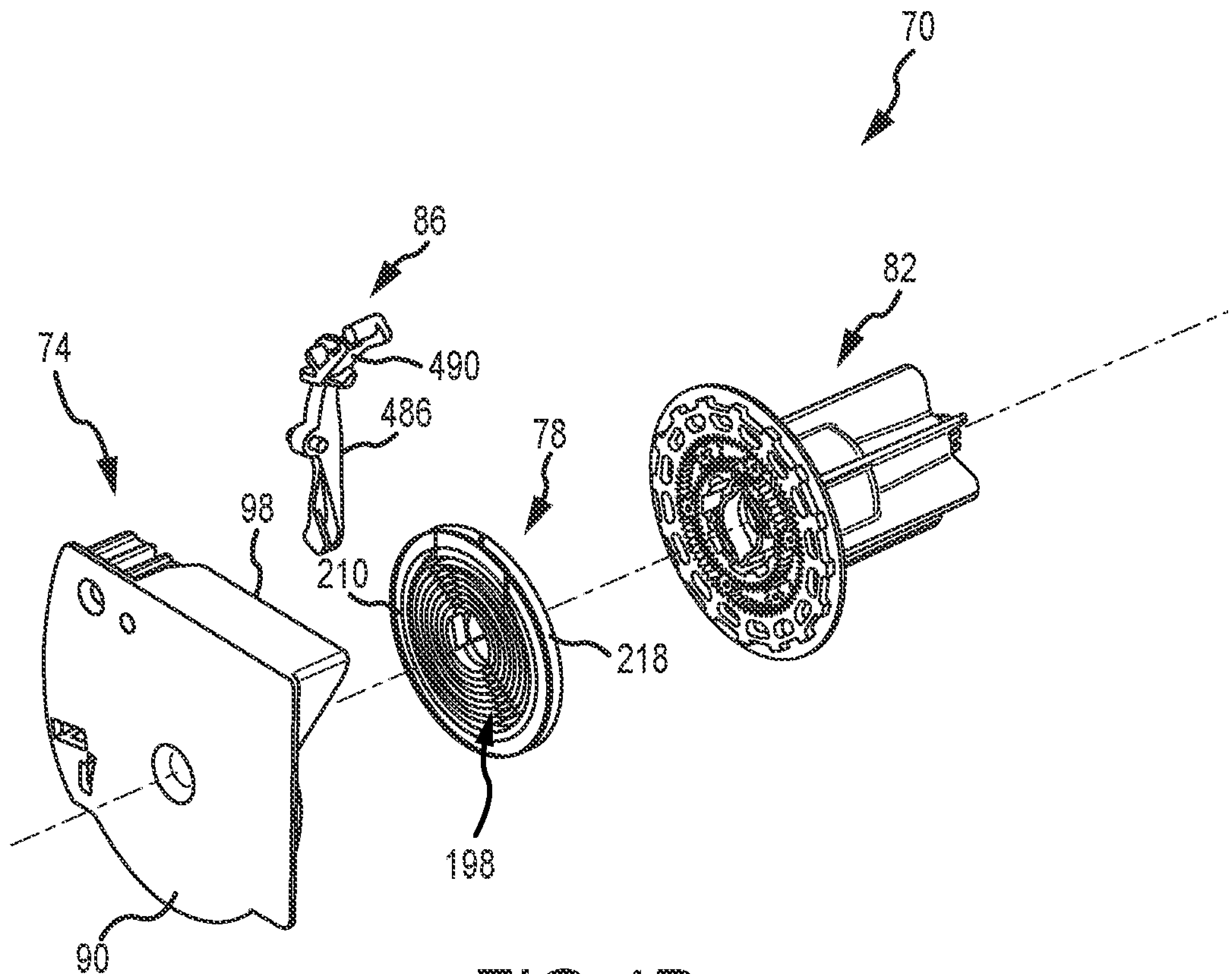
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FIG.4B

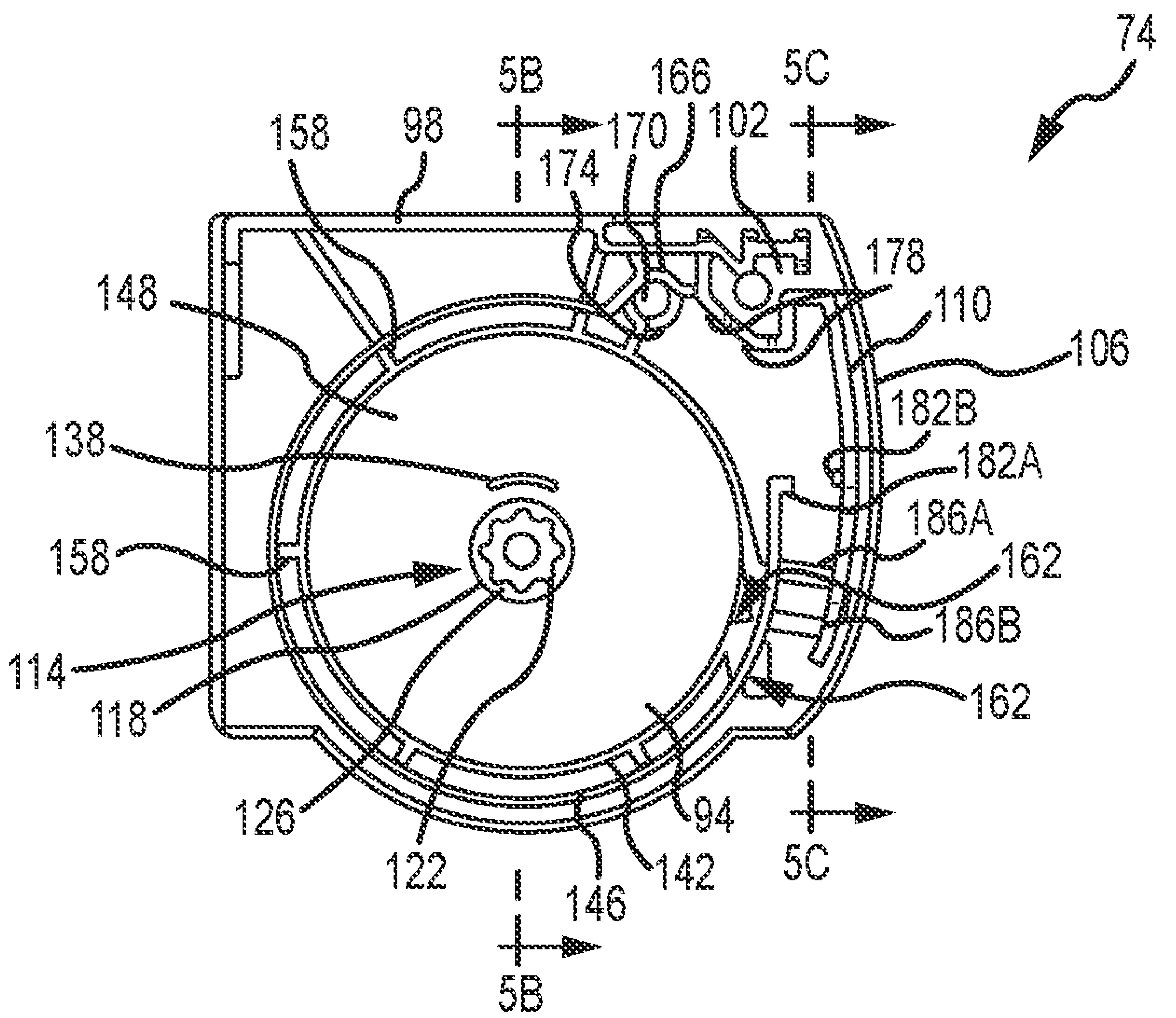
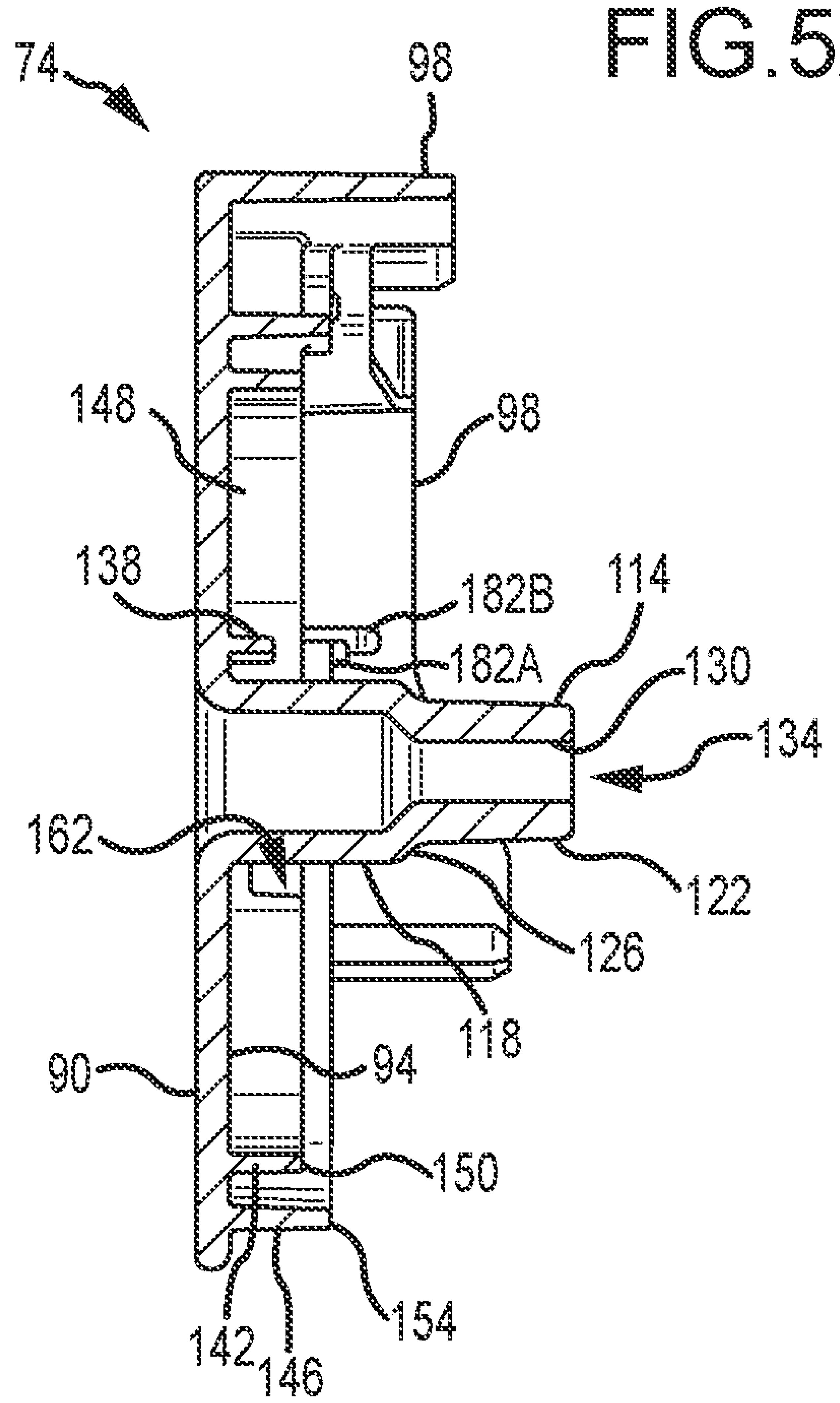


FIG.5A



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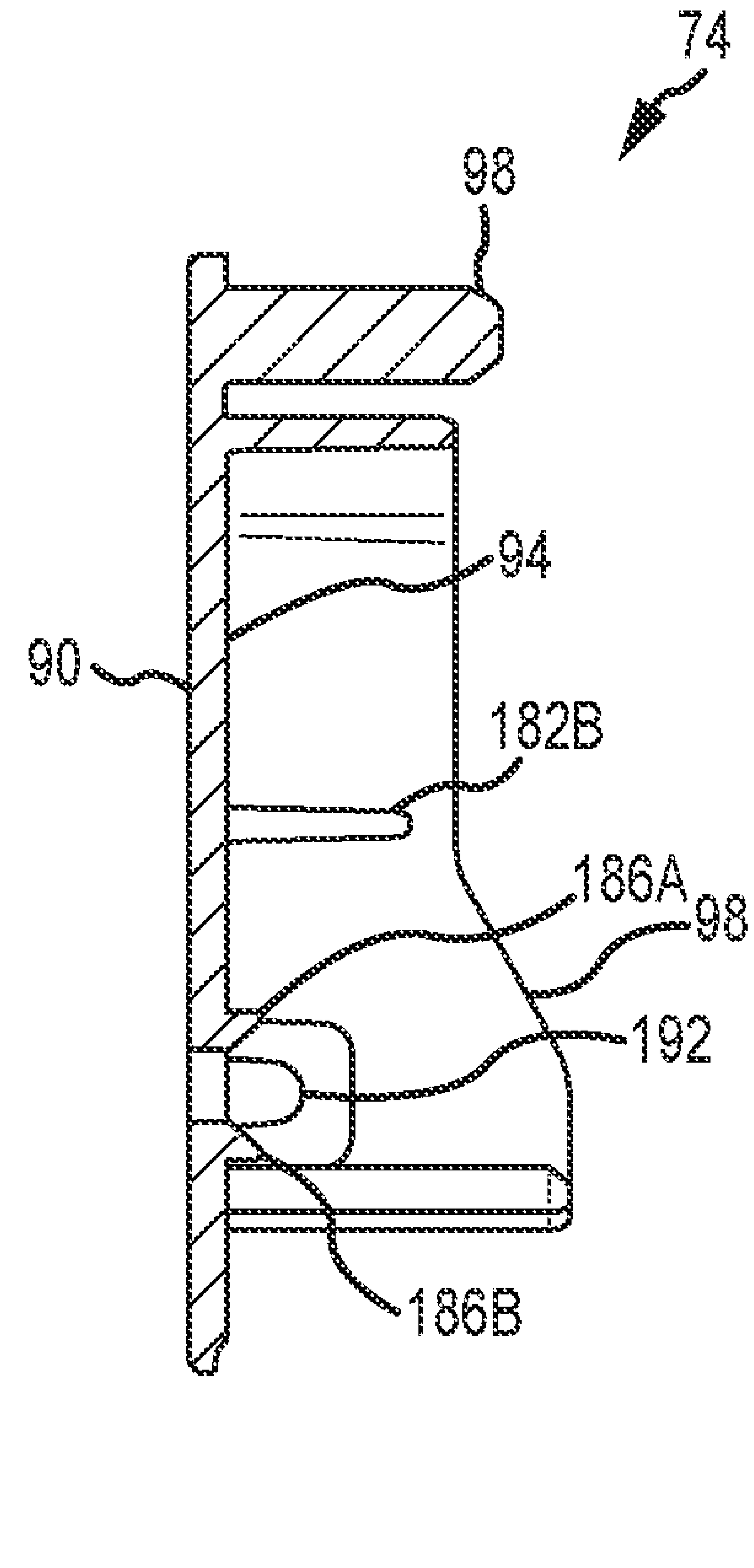

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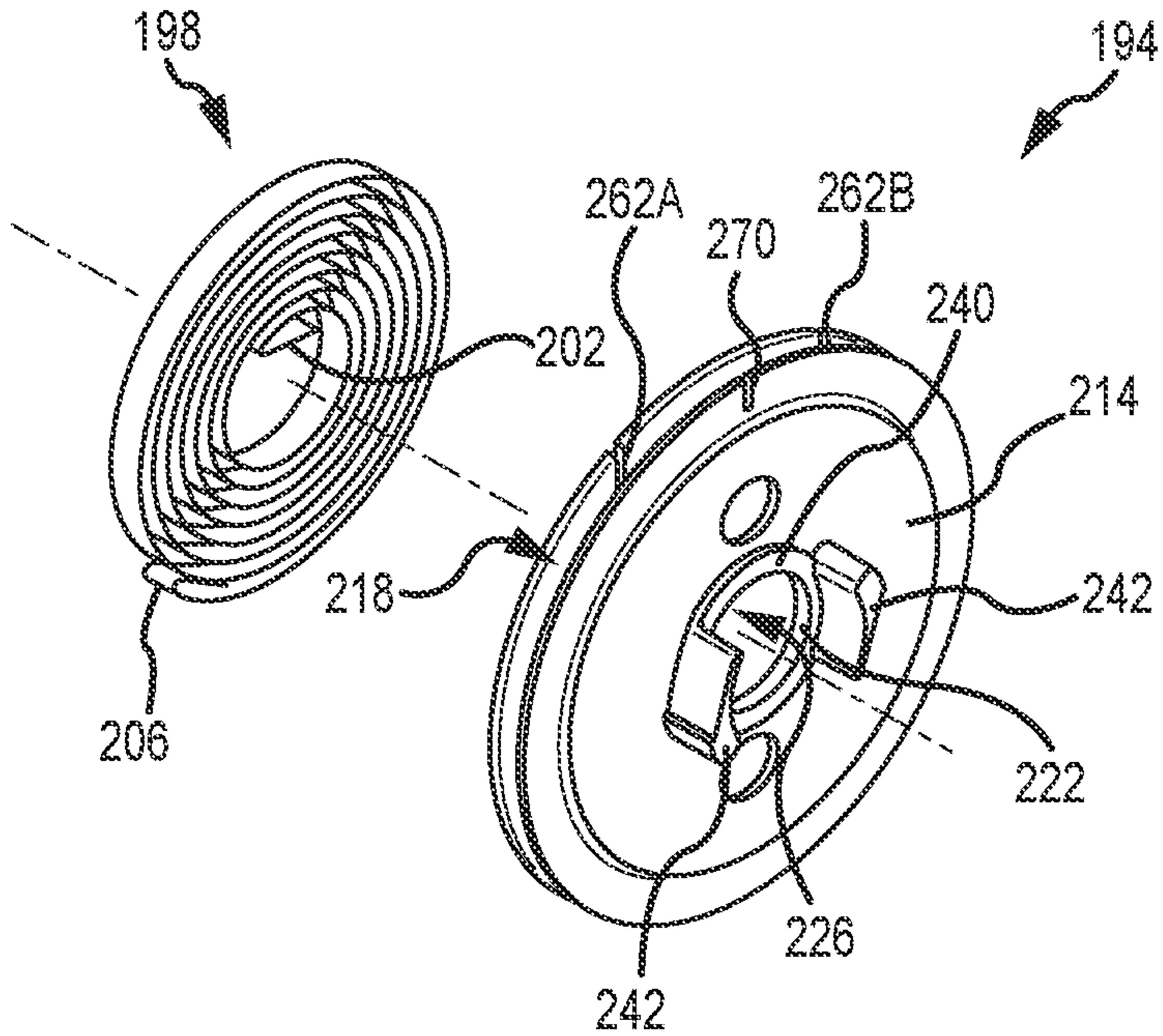
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FIG.6A

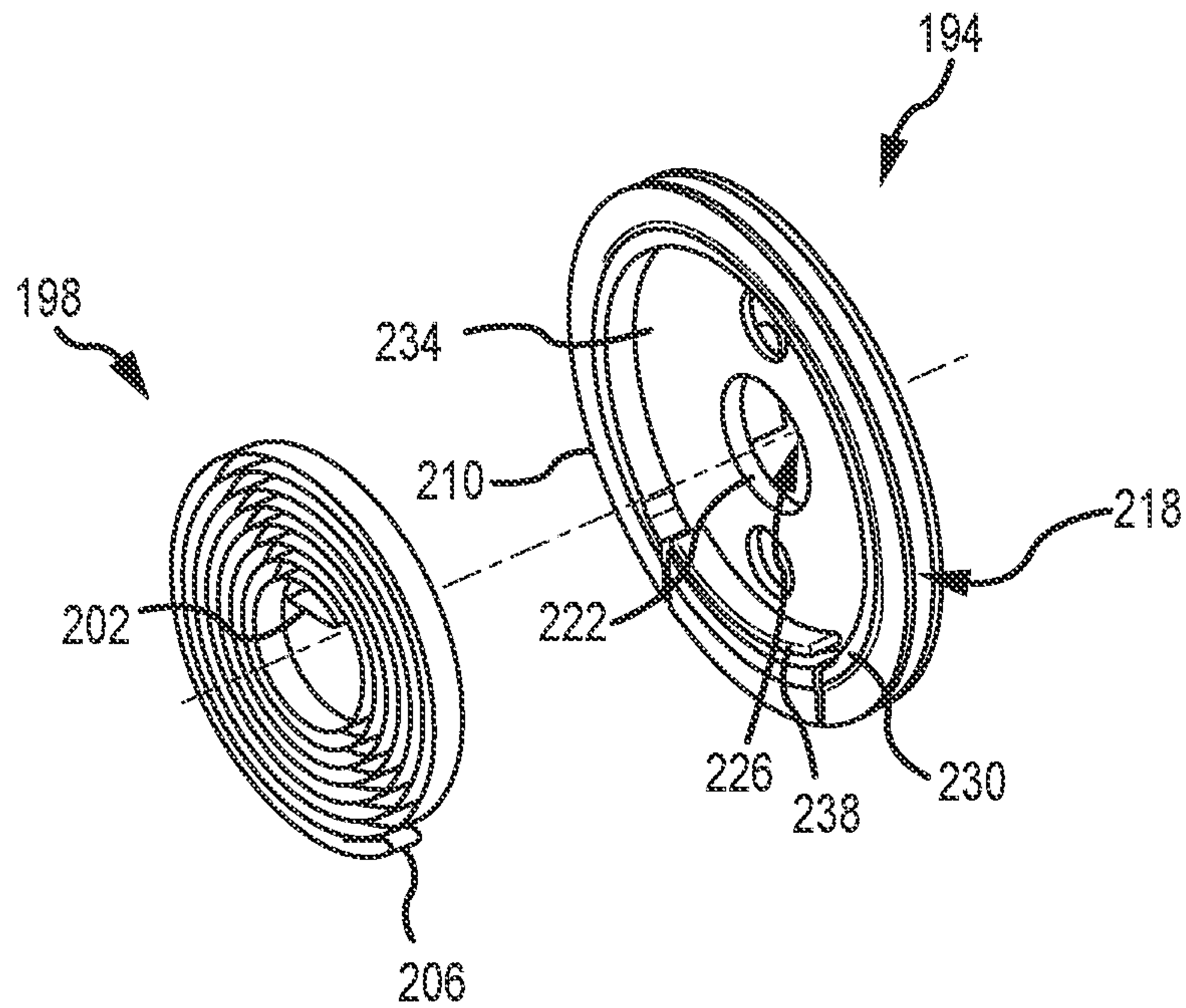
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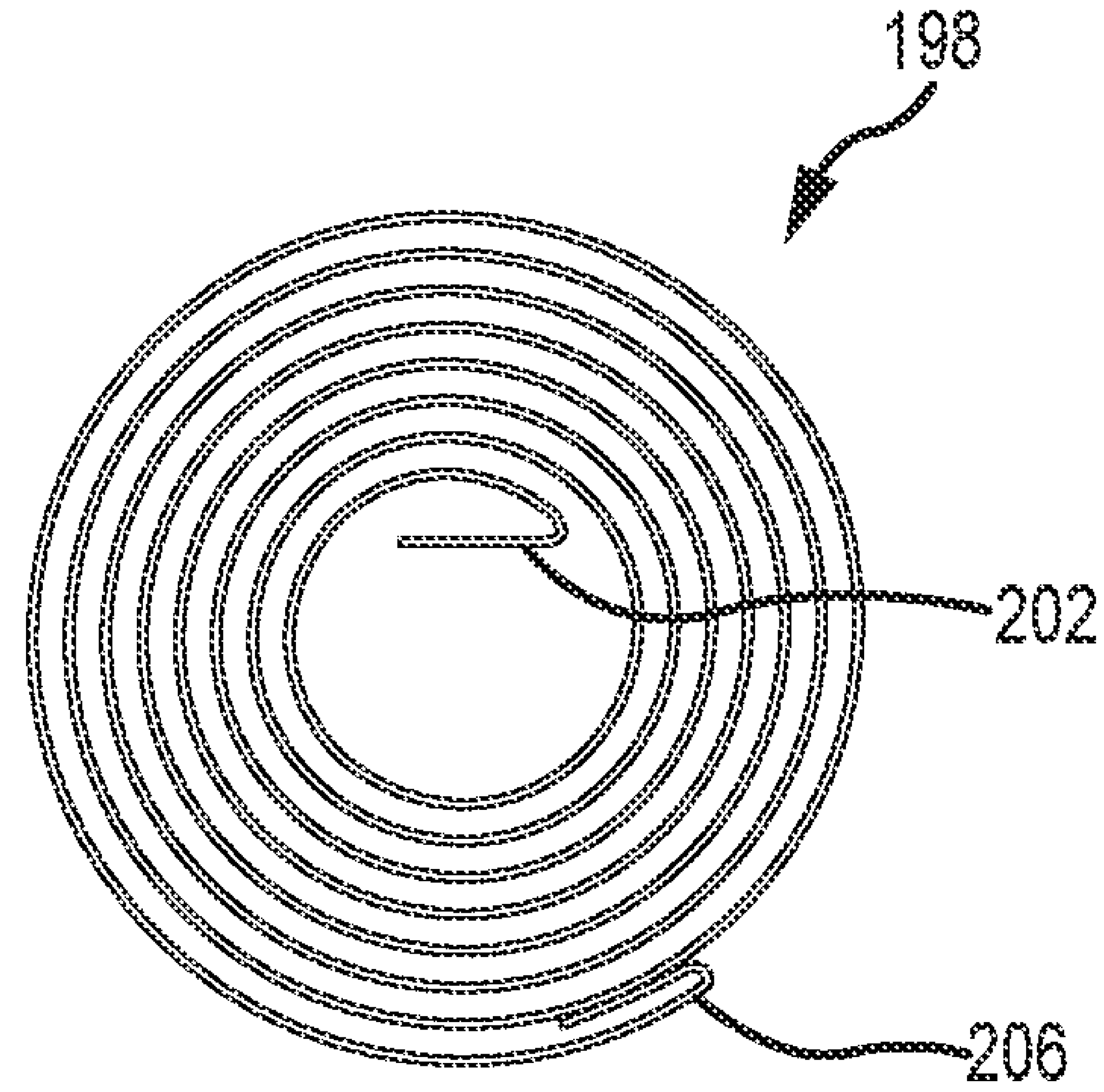
FIG.6B



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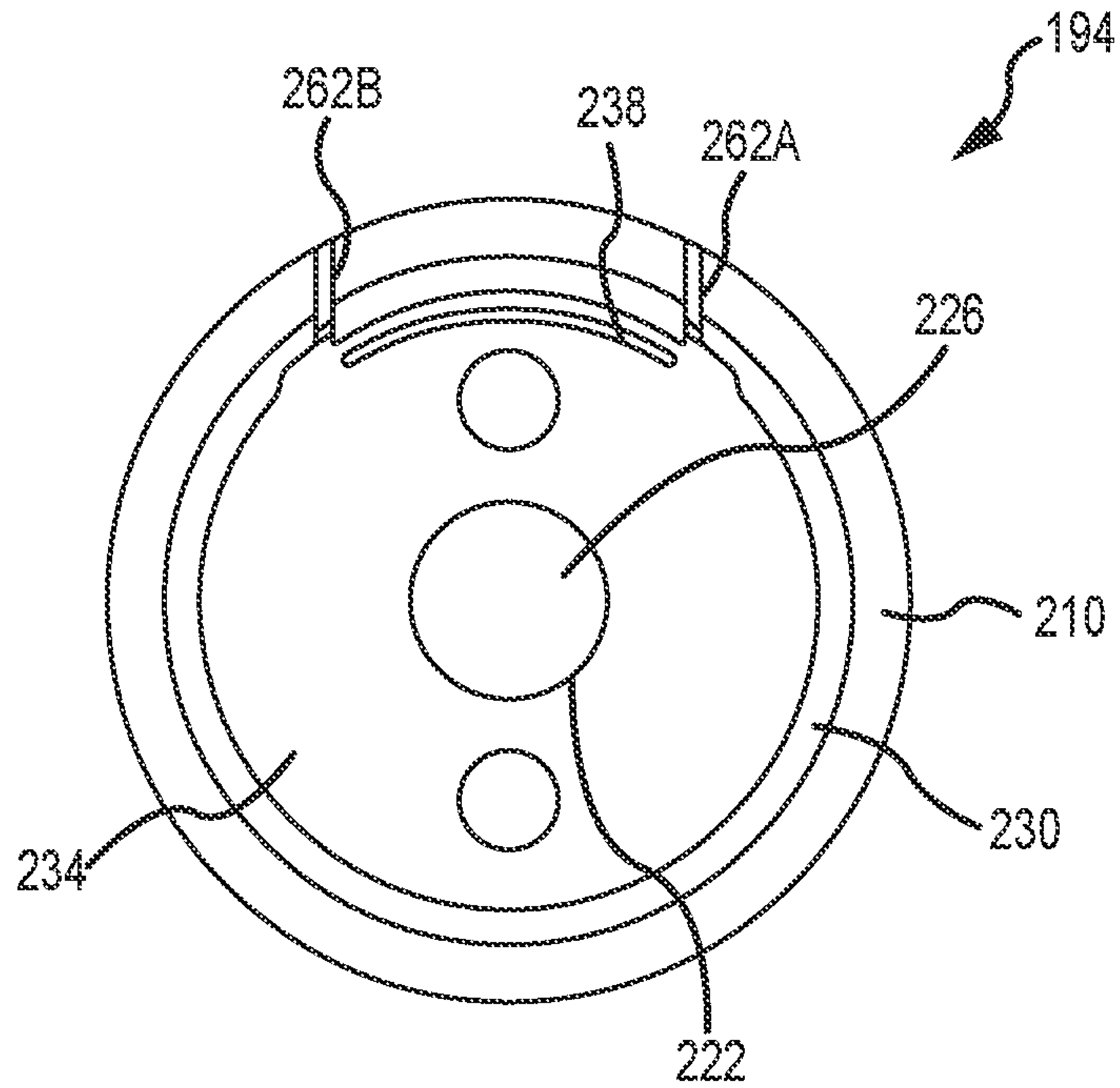

FIG.8A

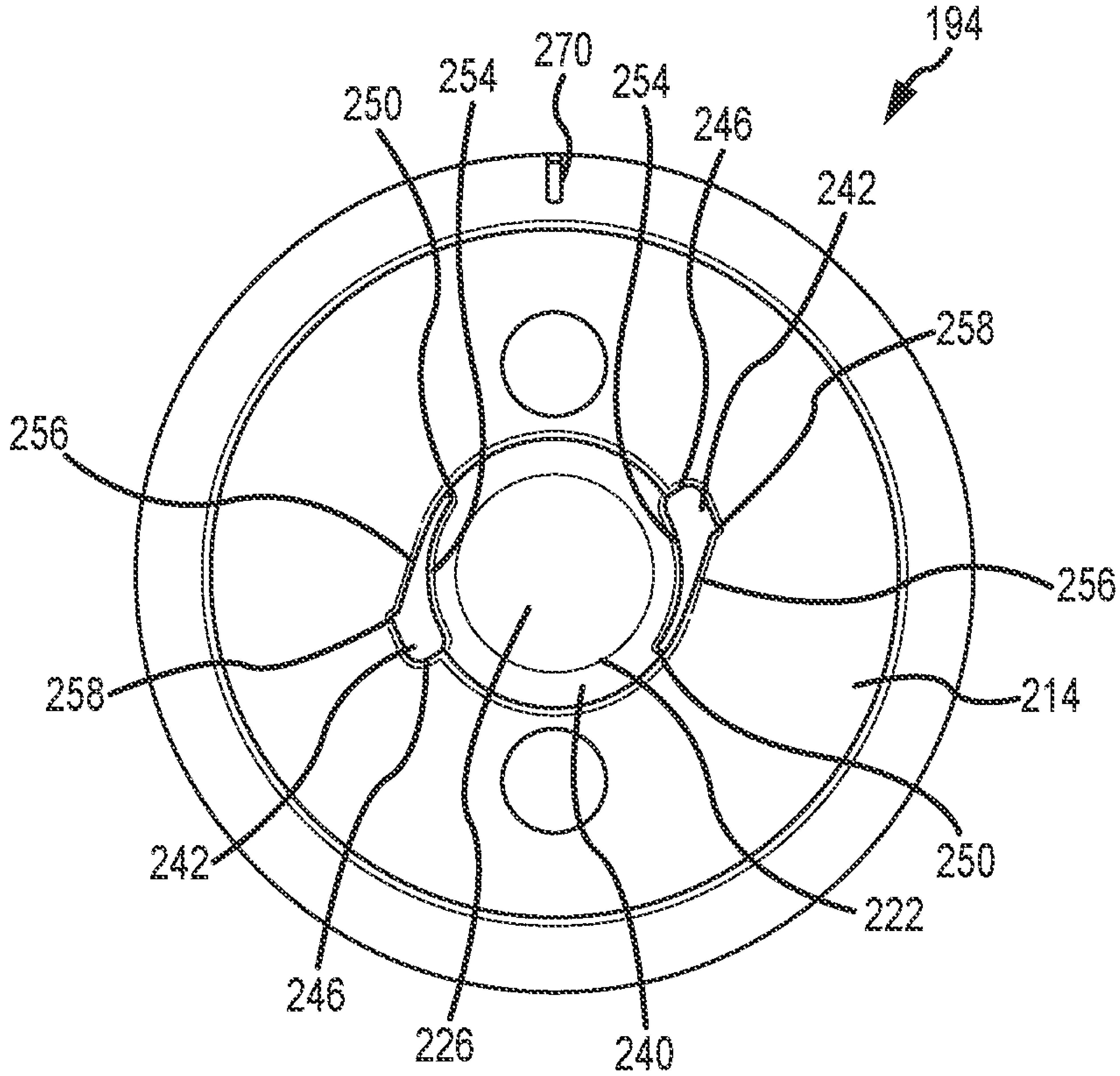
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FIG.8B

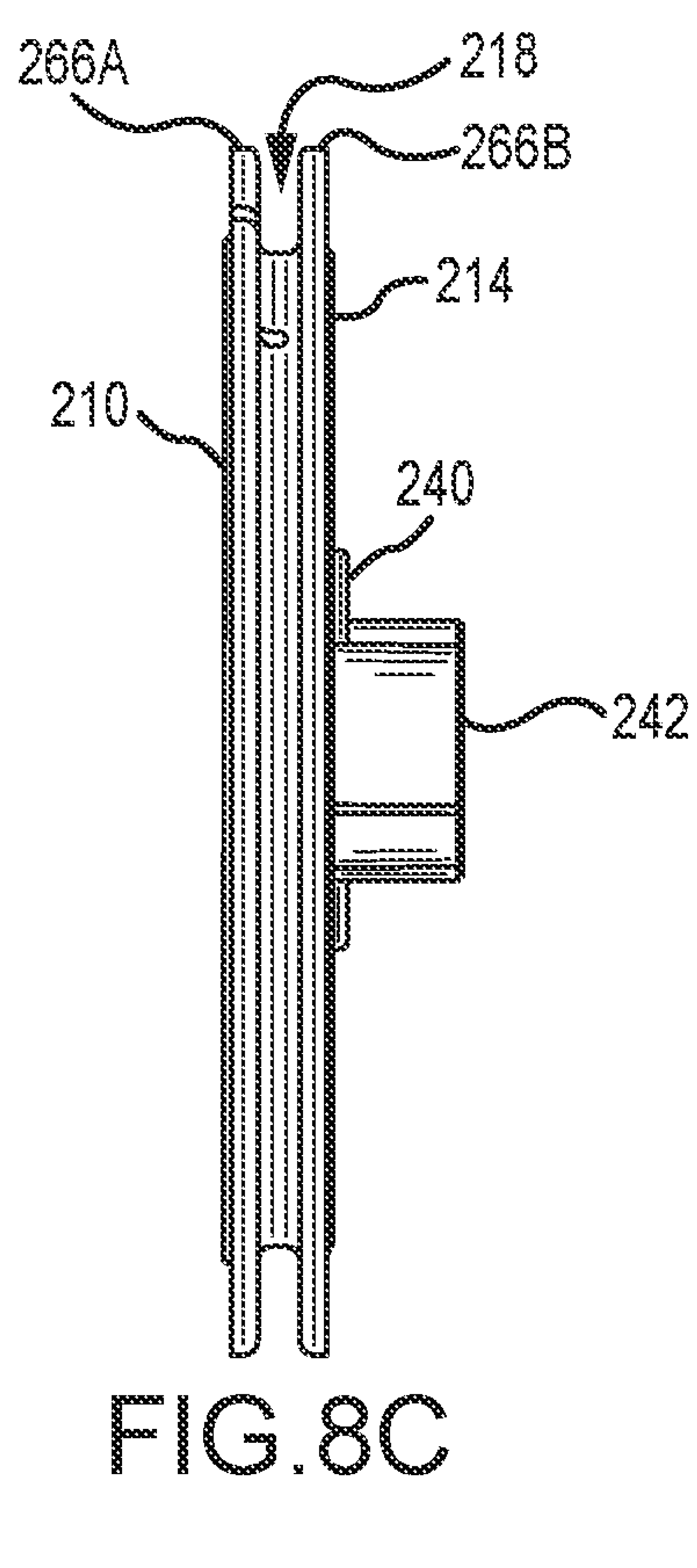
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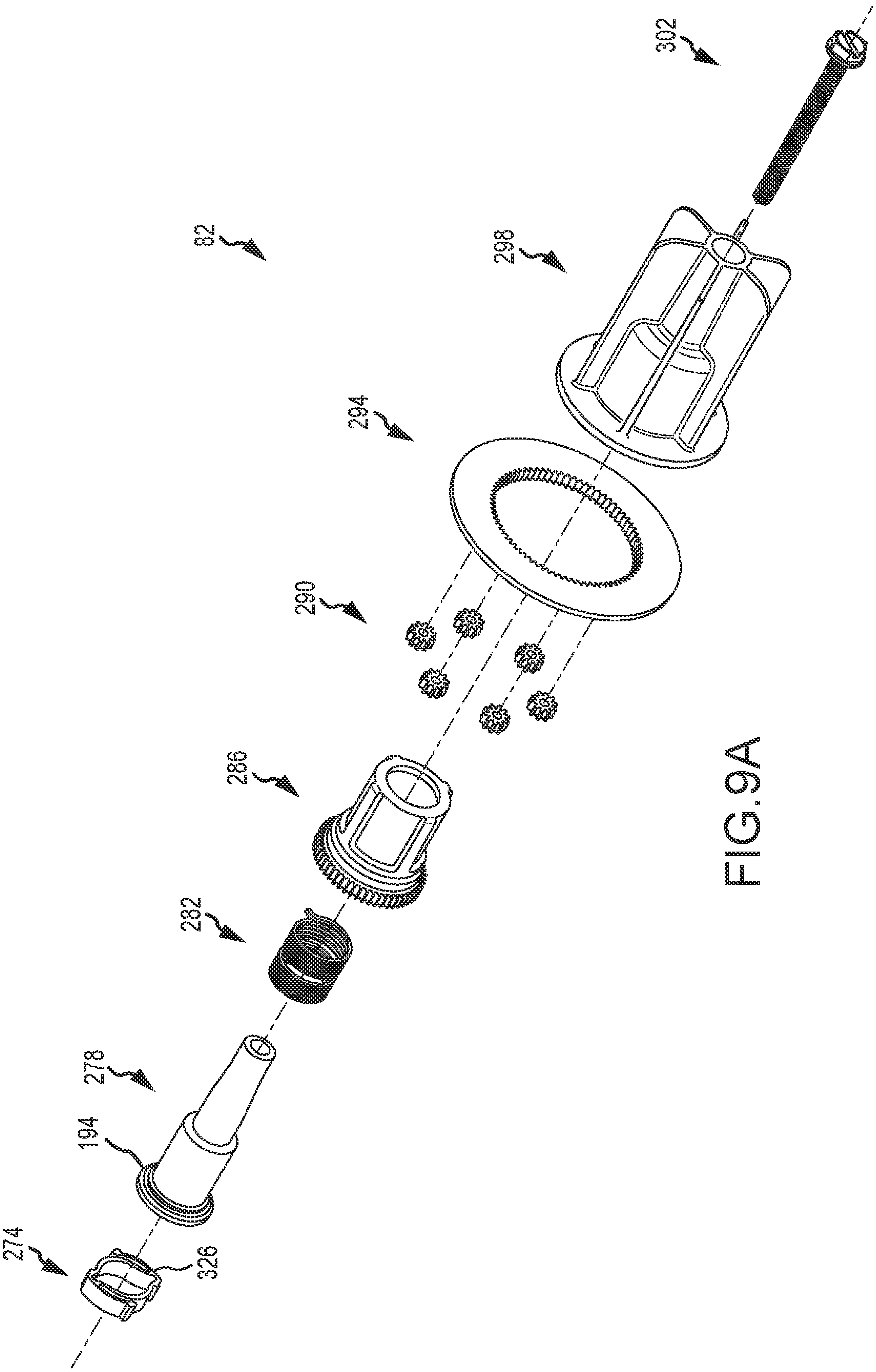
FIG.8C



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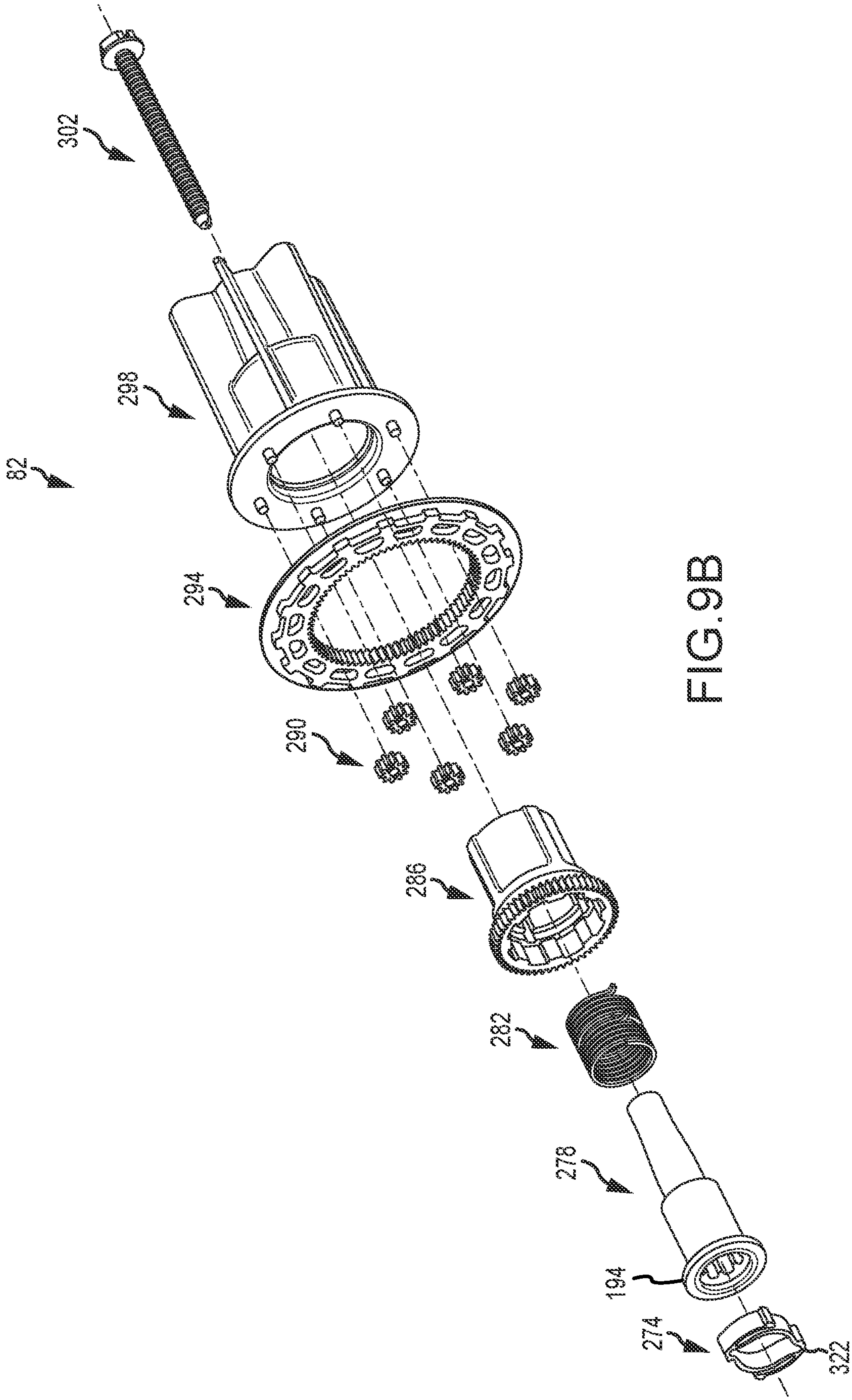

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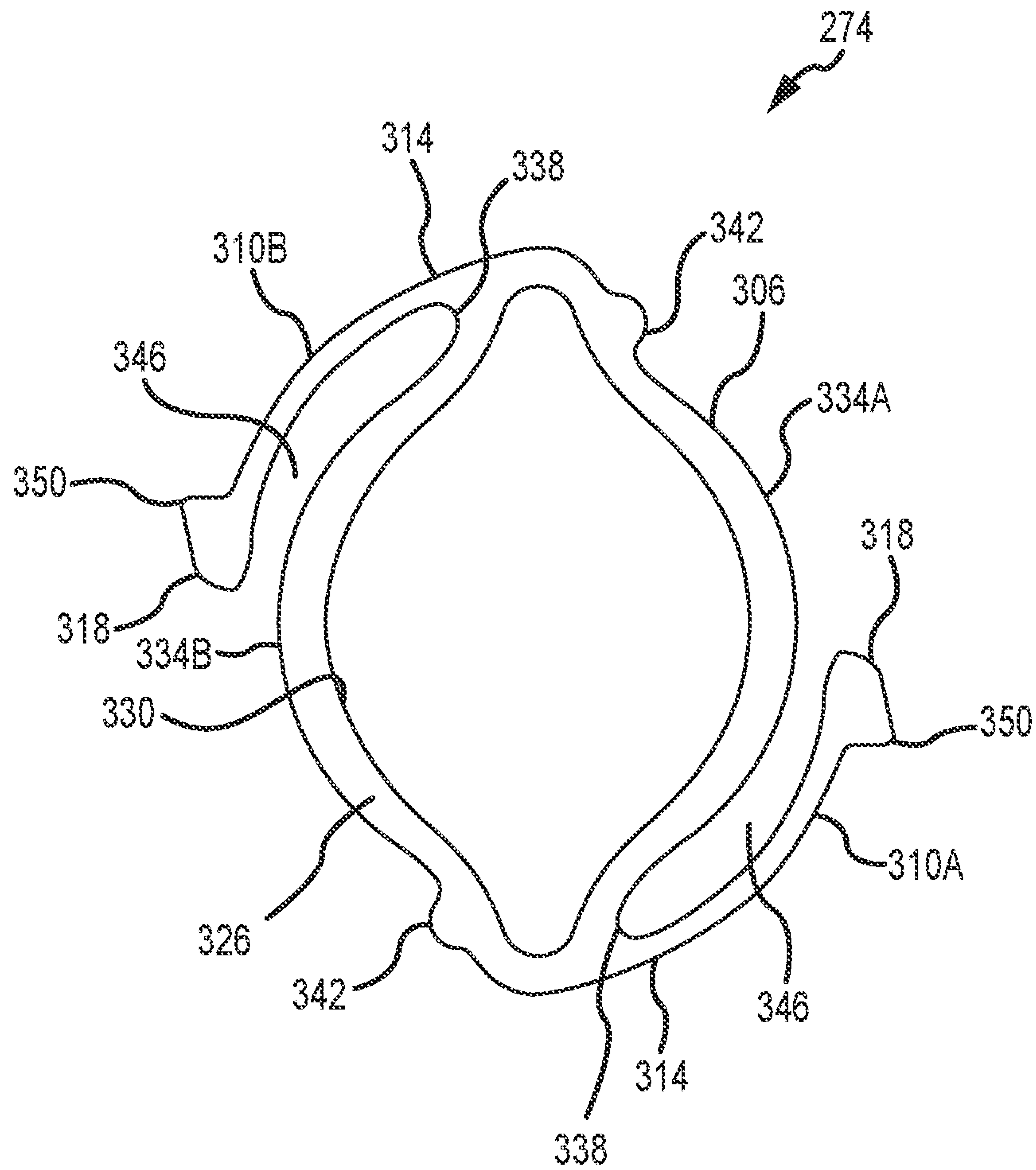
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FIG.10

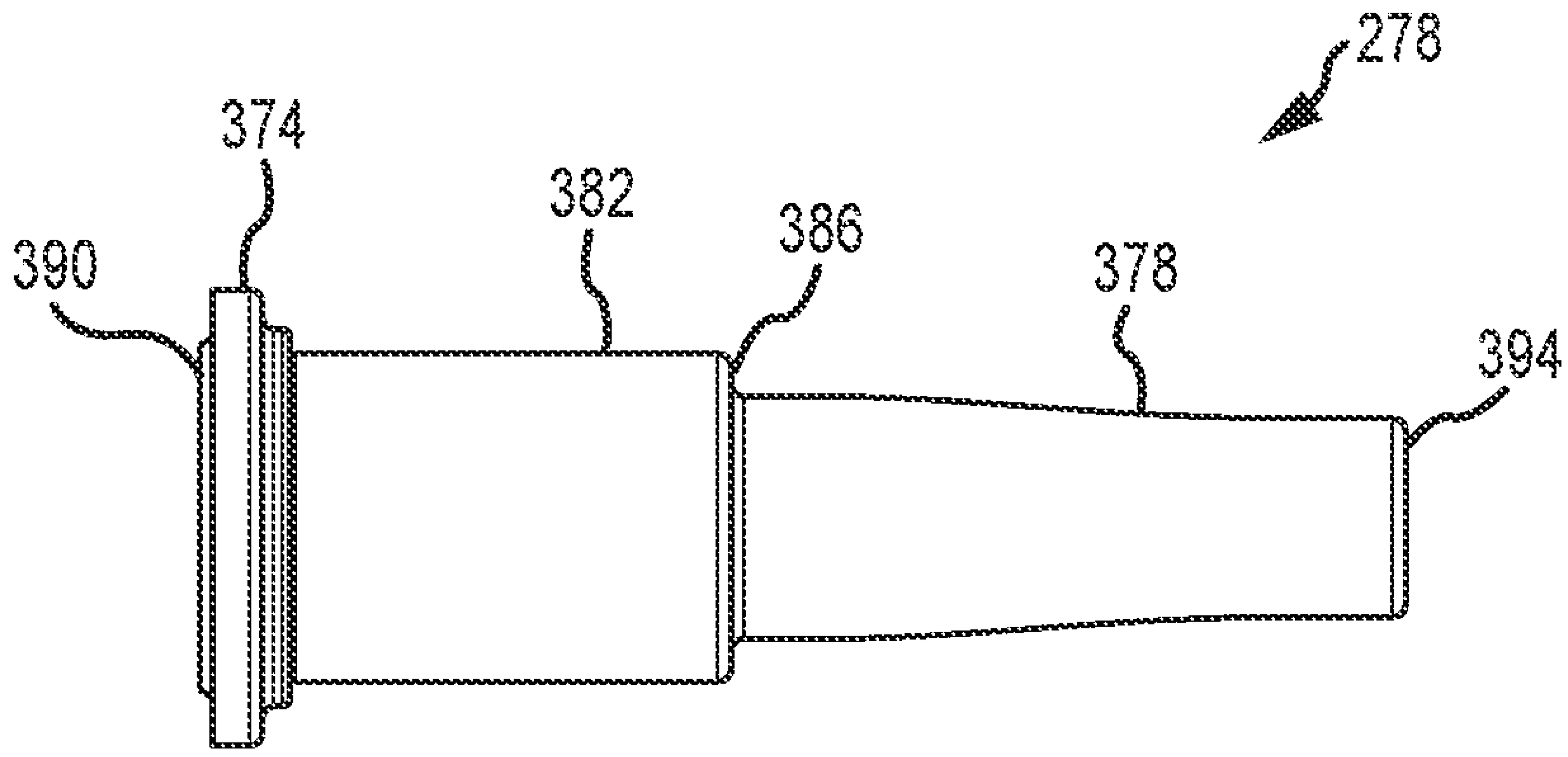


FIG.11A

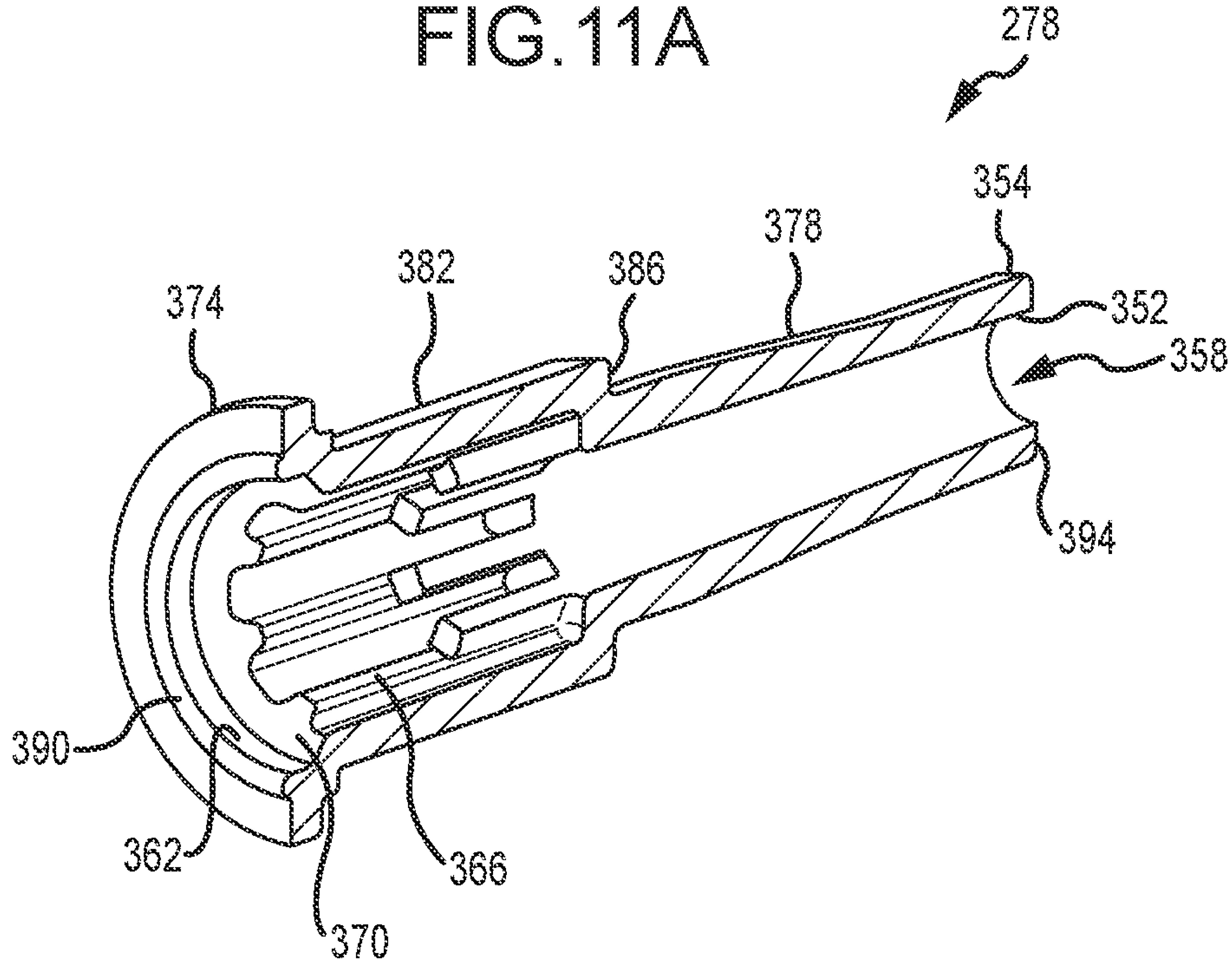


FIG.11B

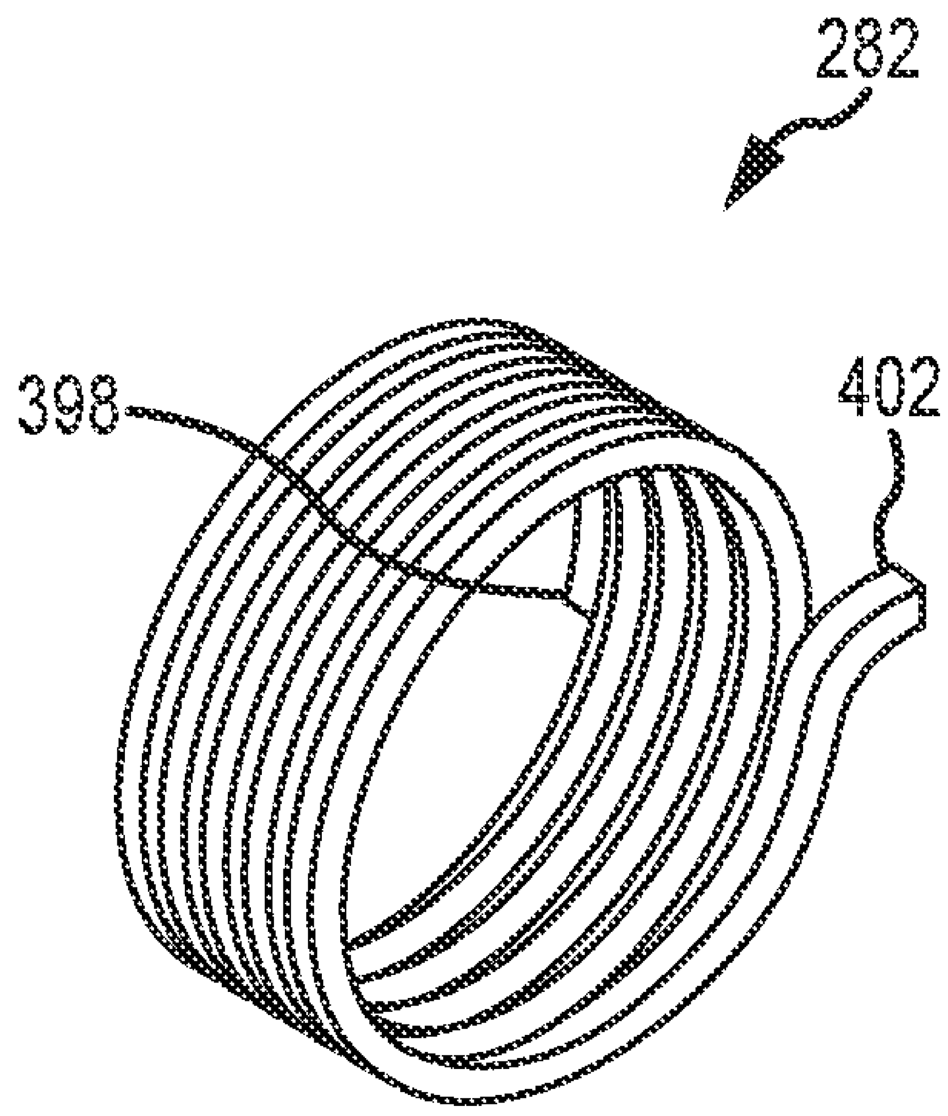


FIG.12A

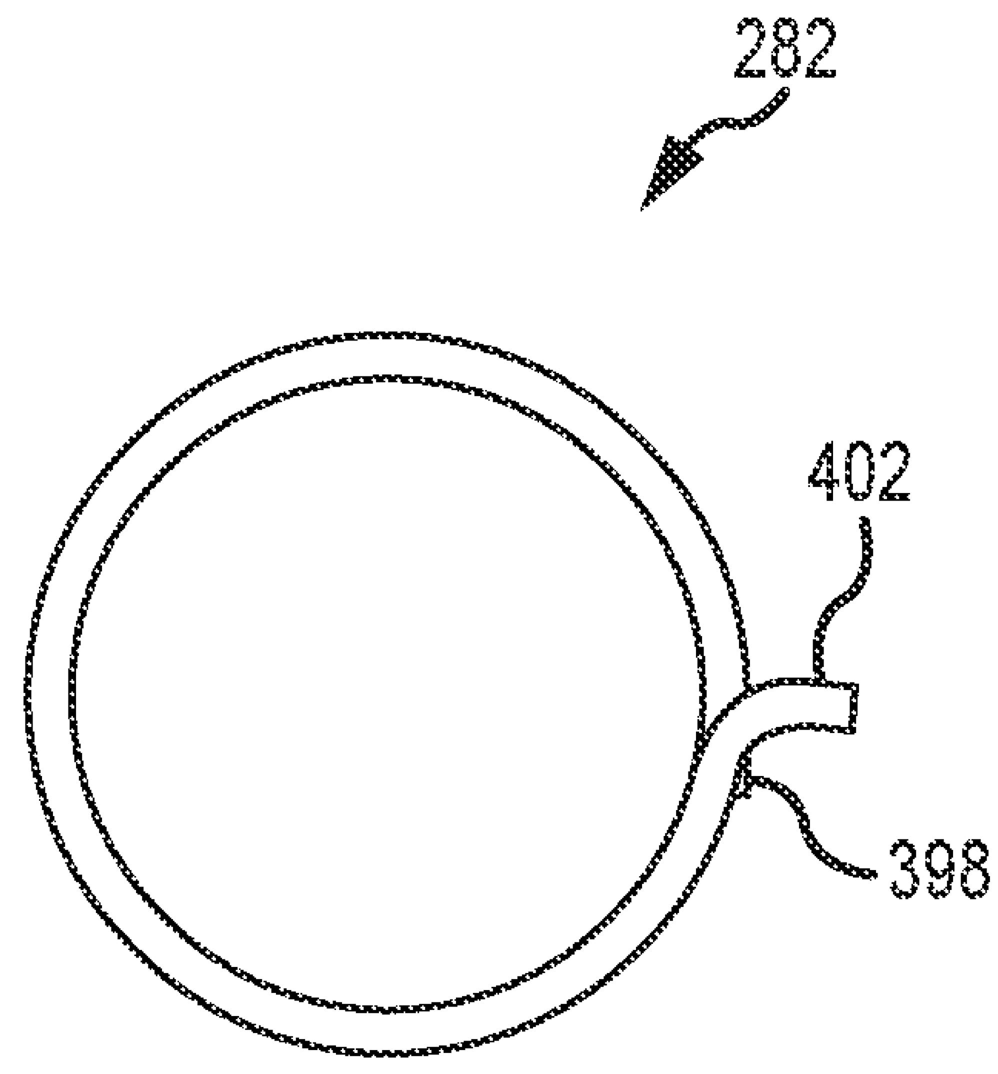


FIG.12B

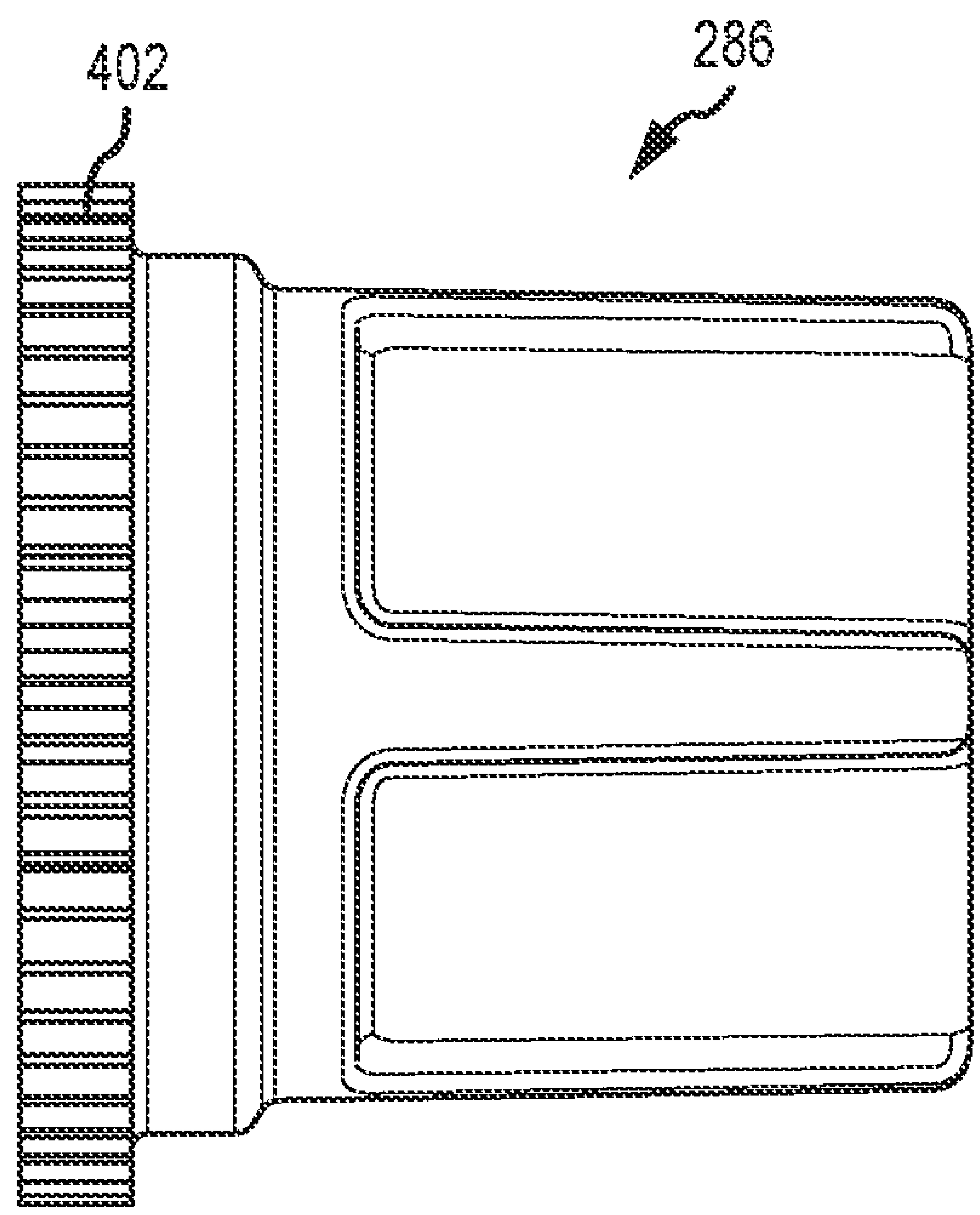
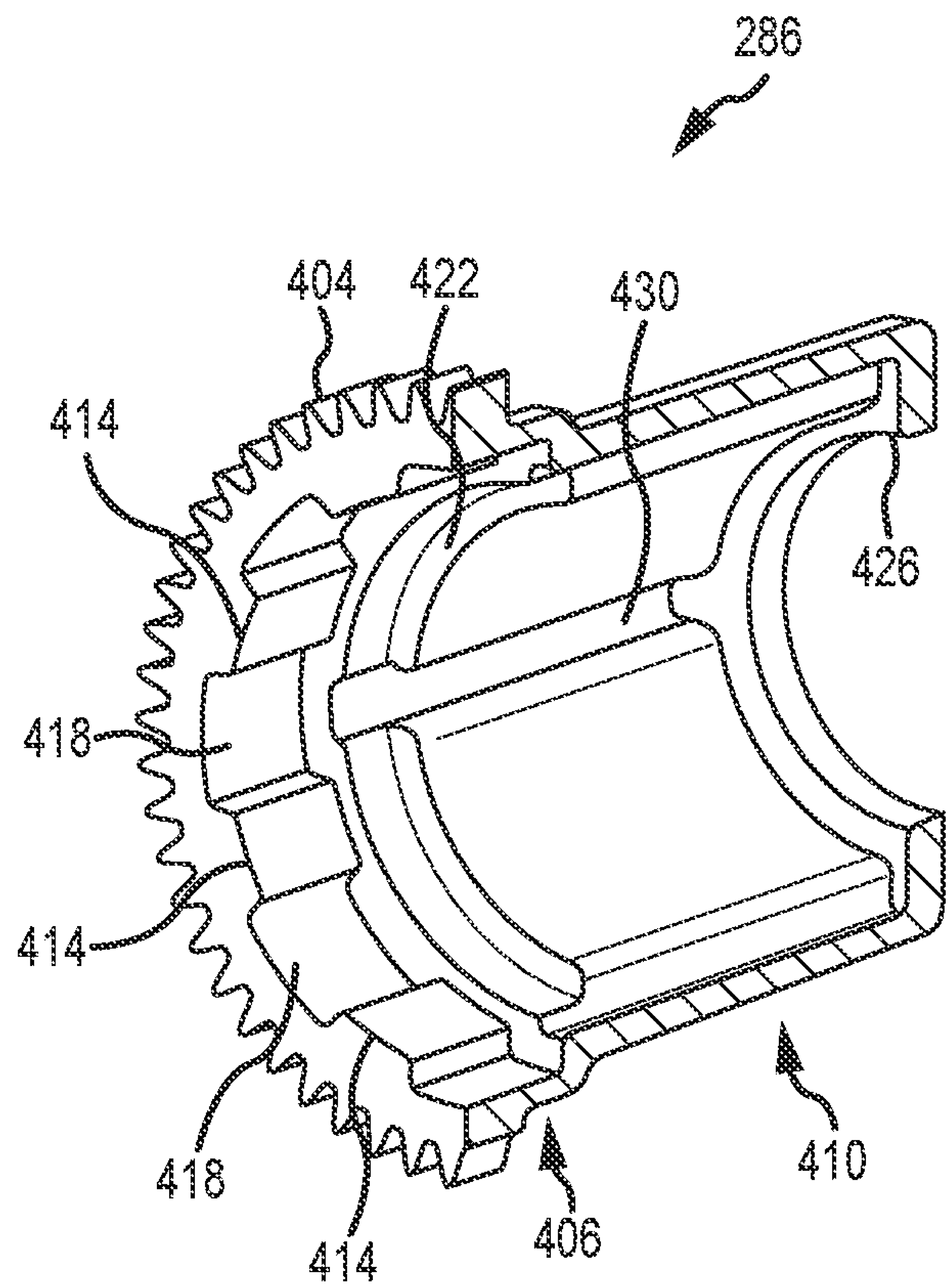


FIG.13A



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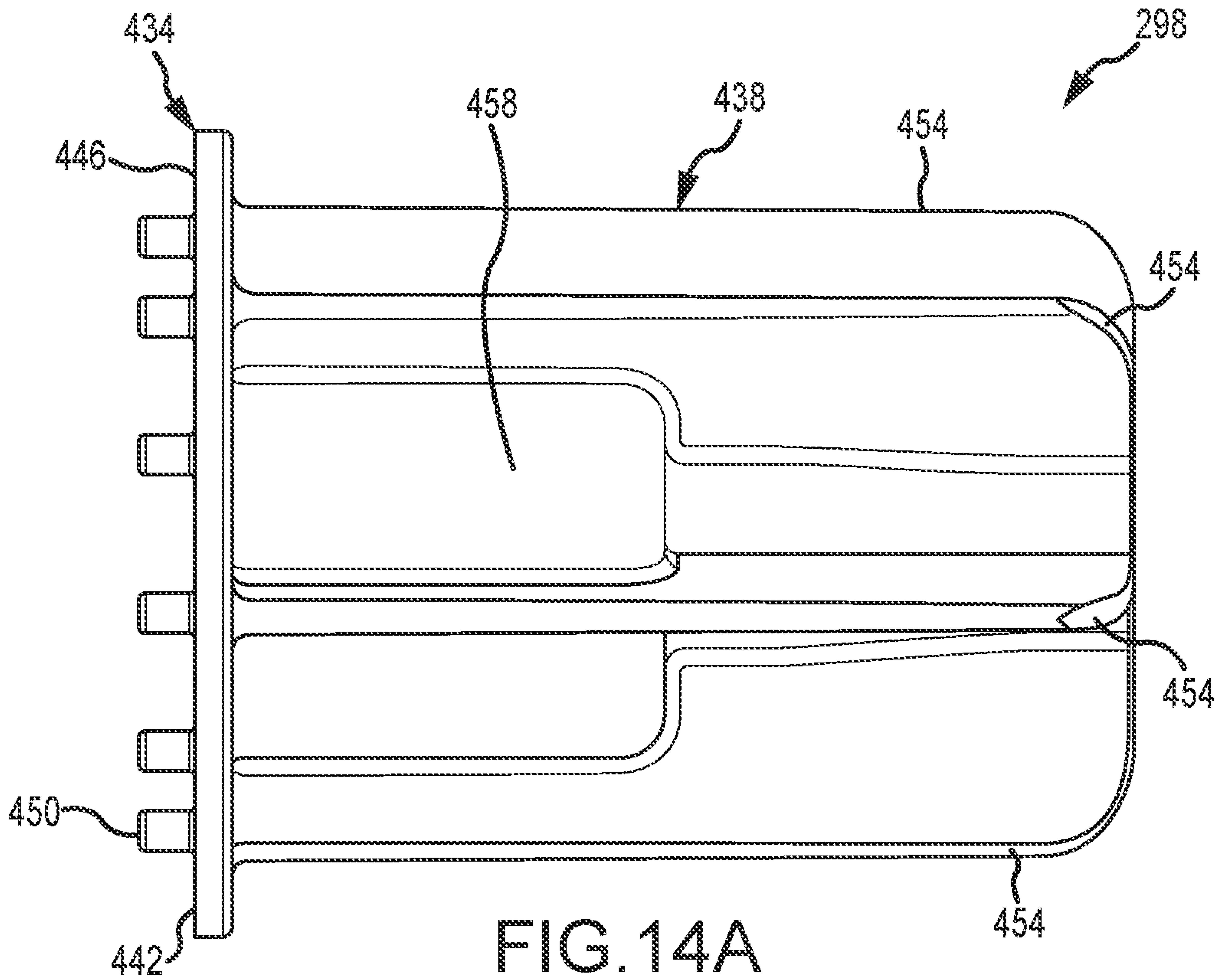
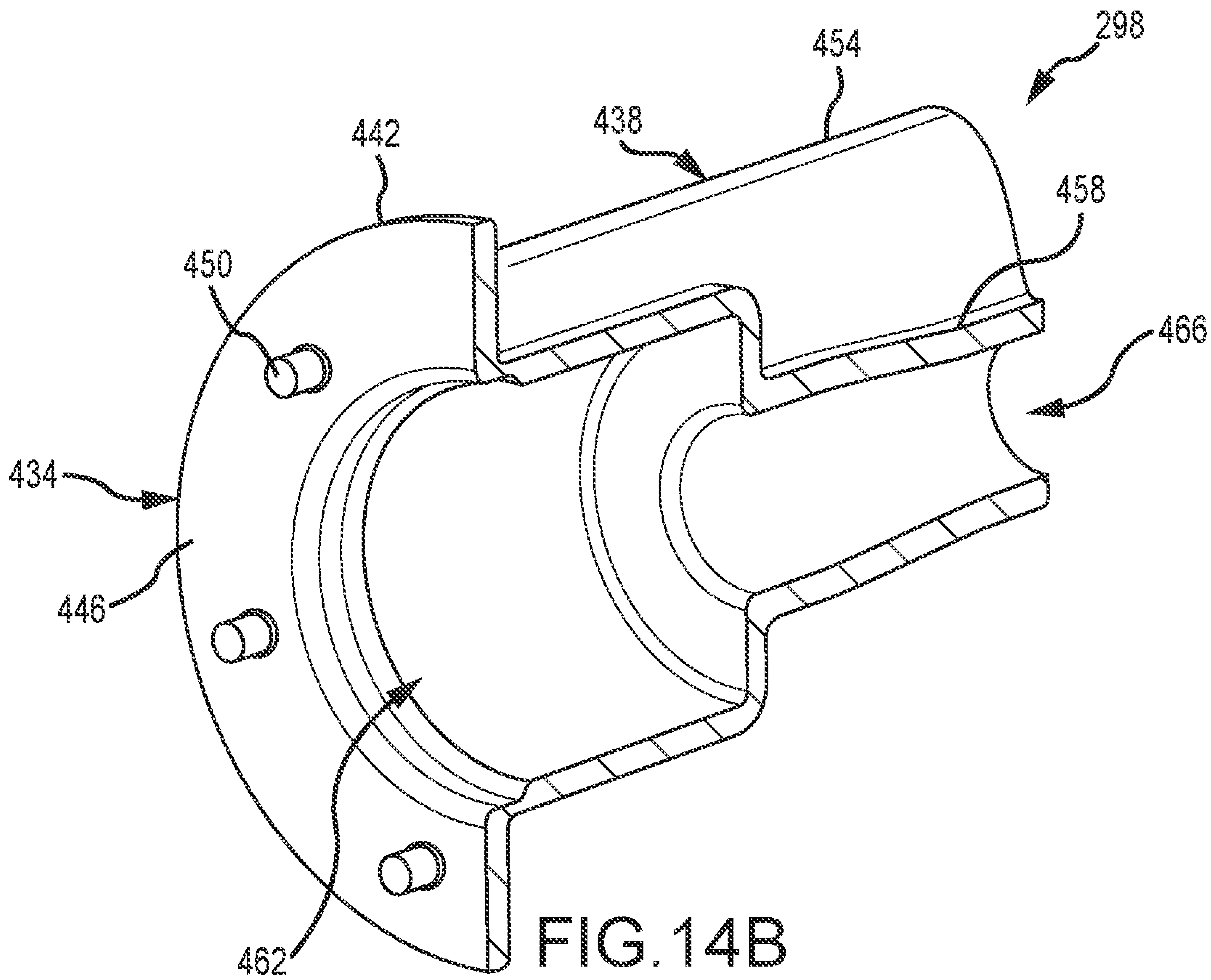


FIG.14A



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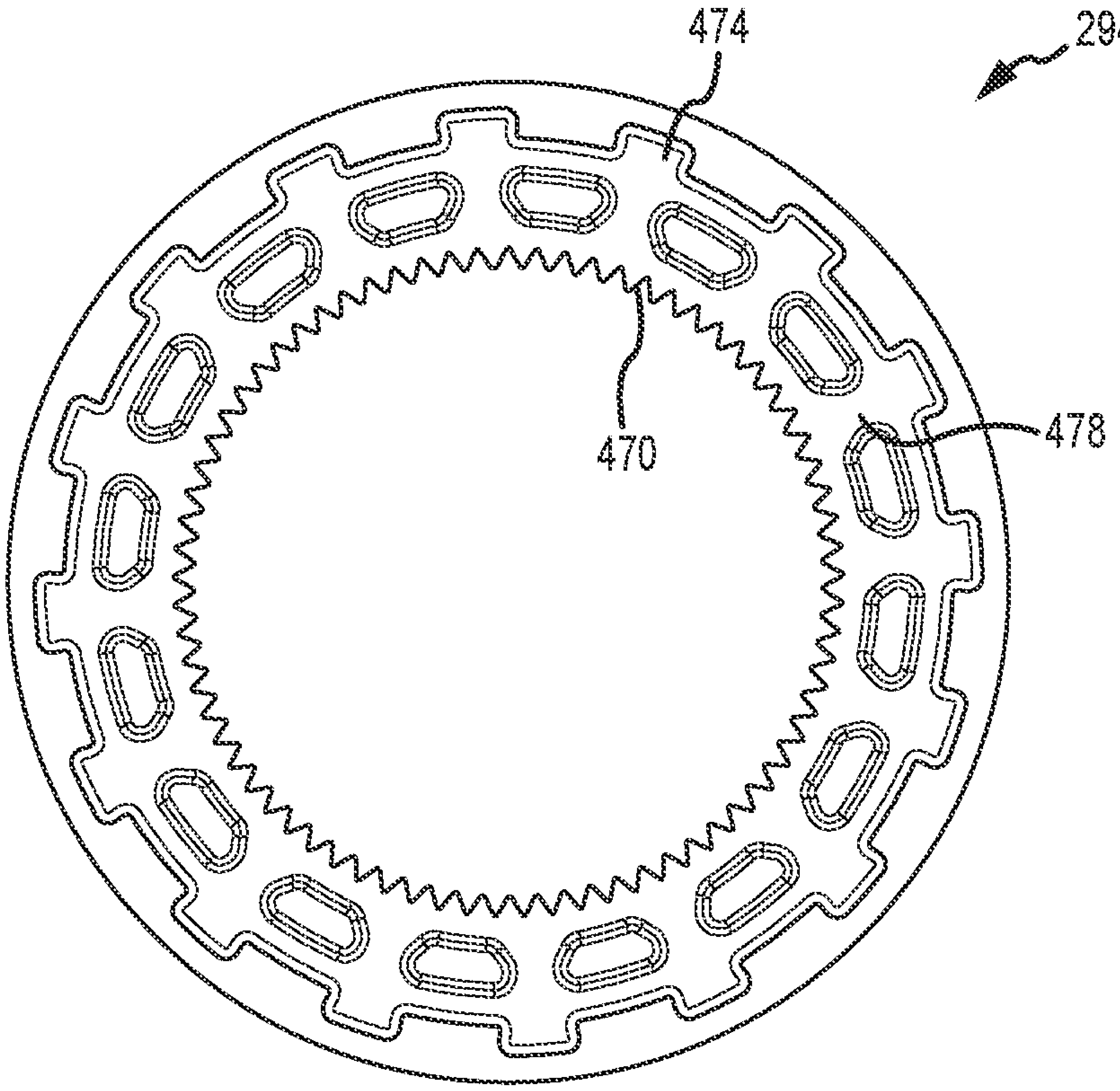
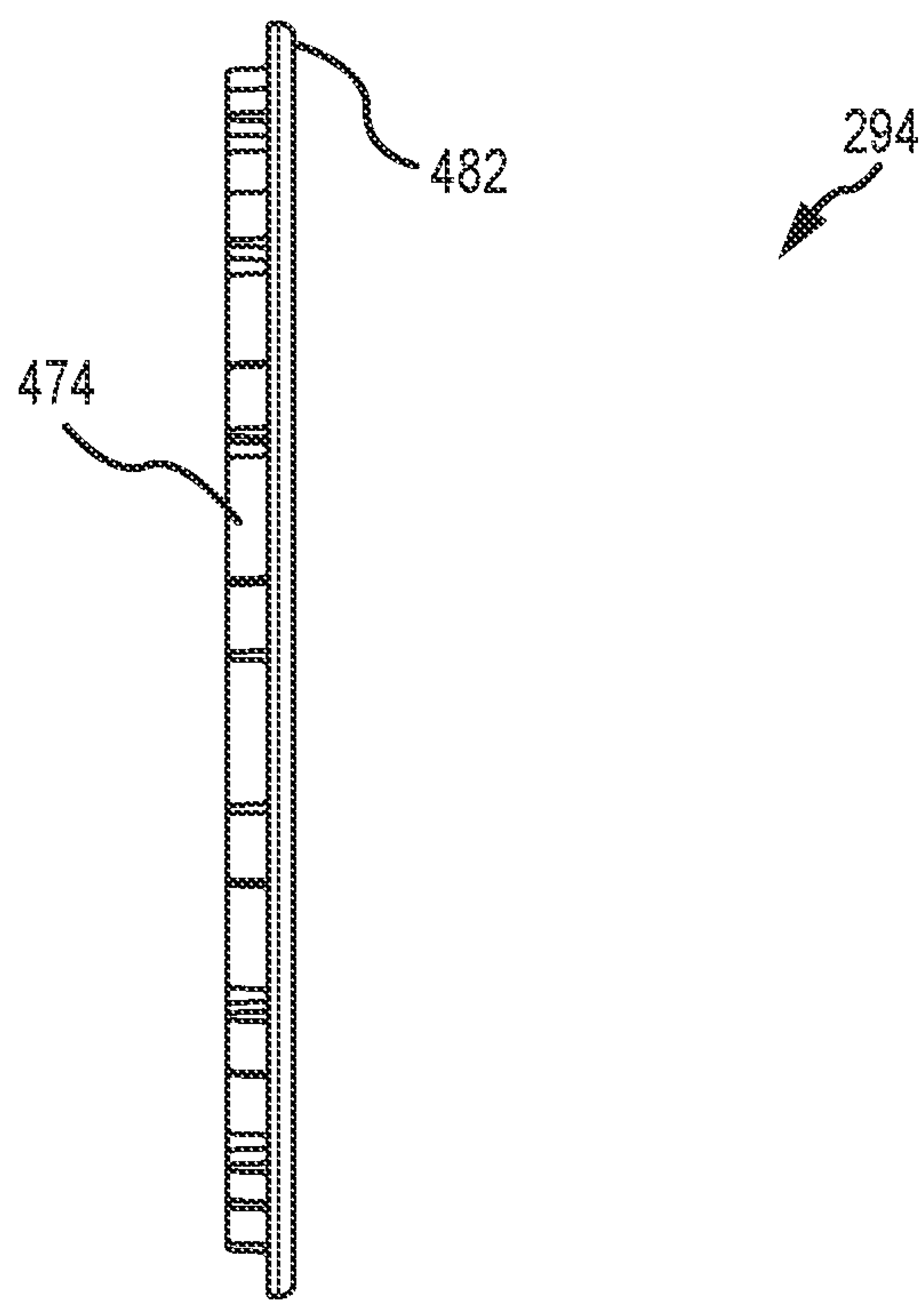


FIG.15A



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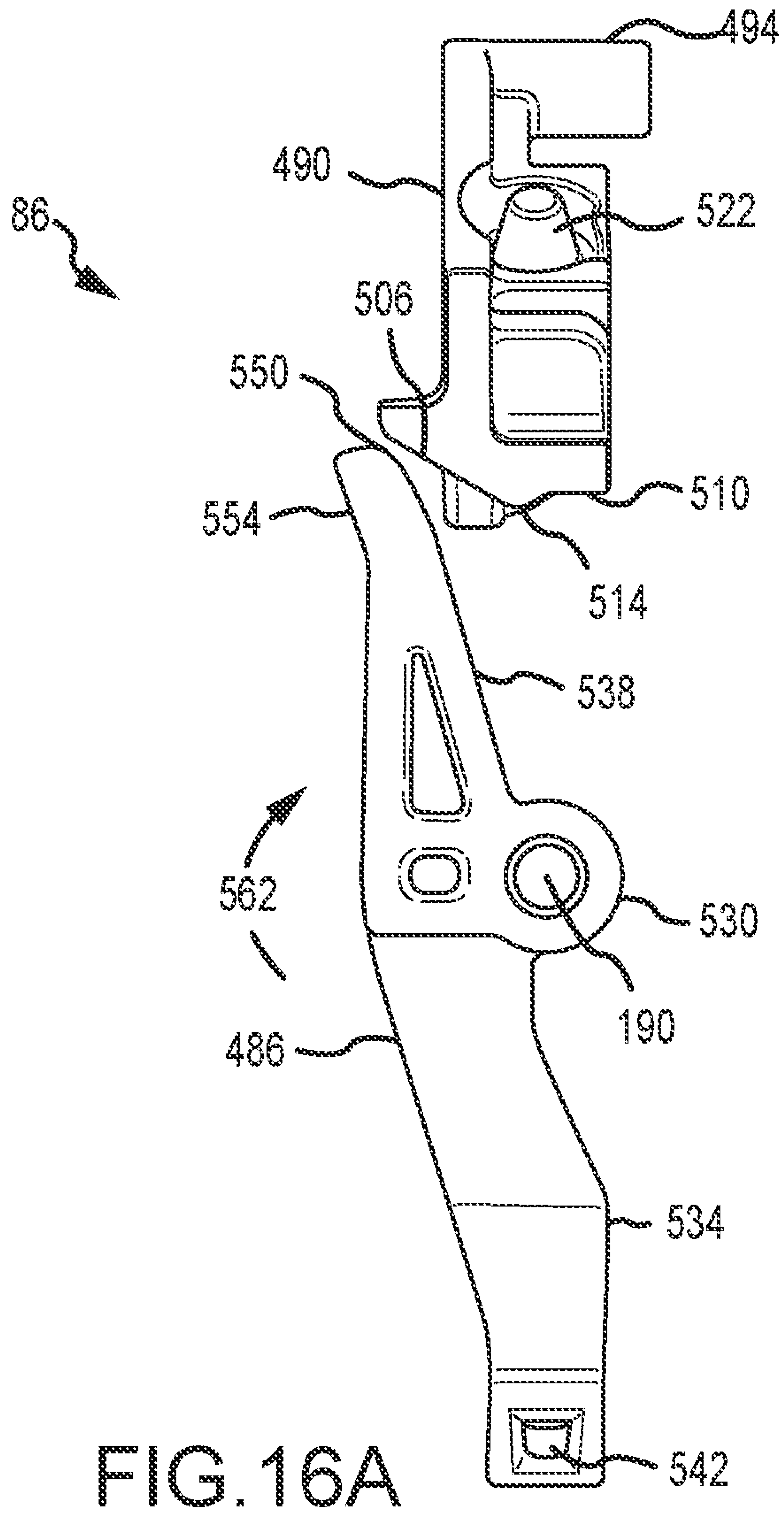


FIG.16A

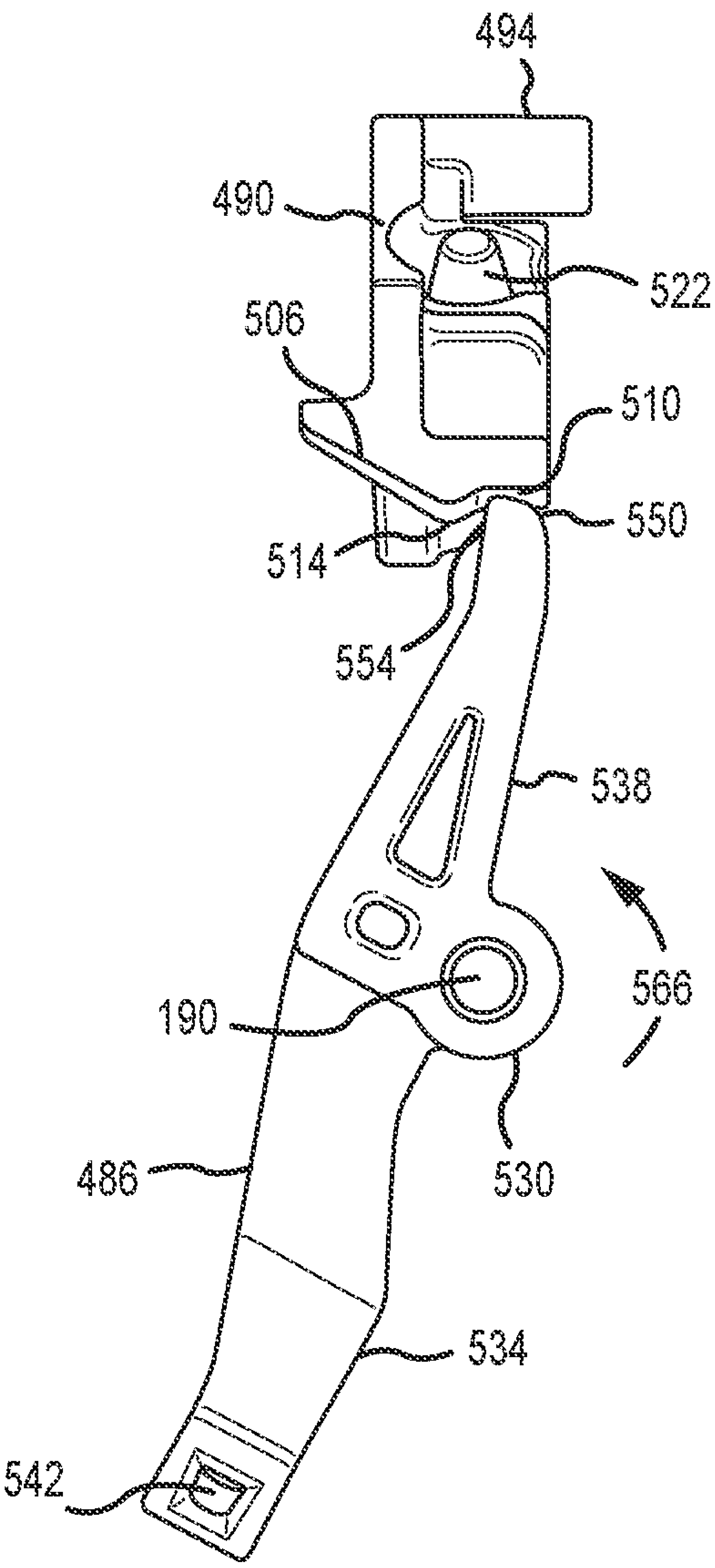


FIG.16B

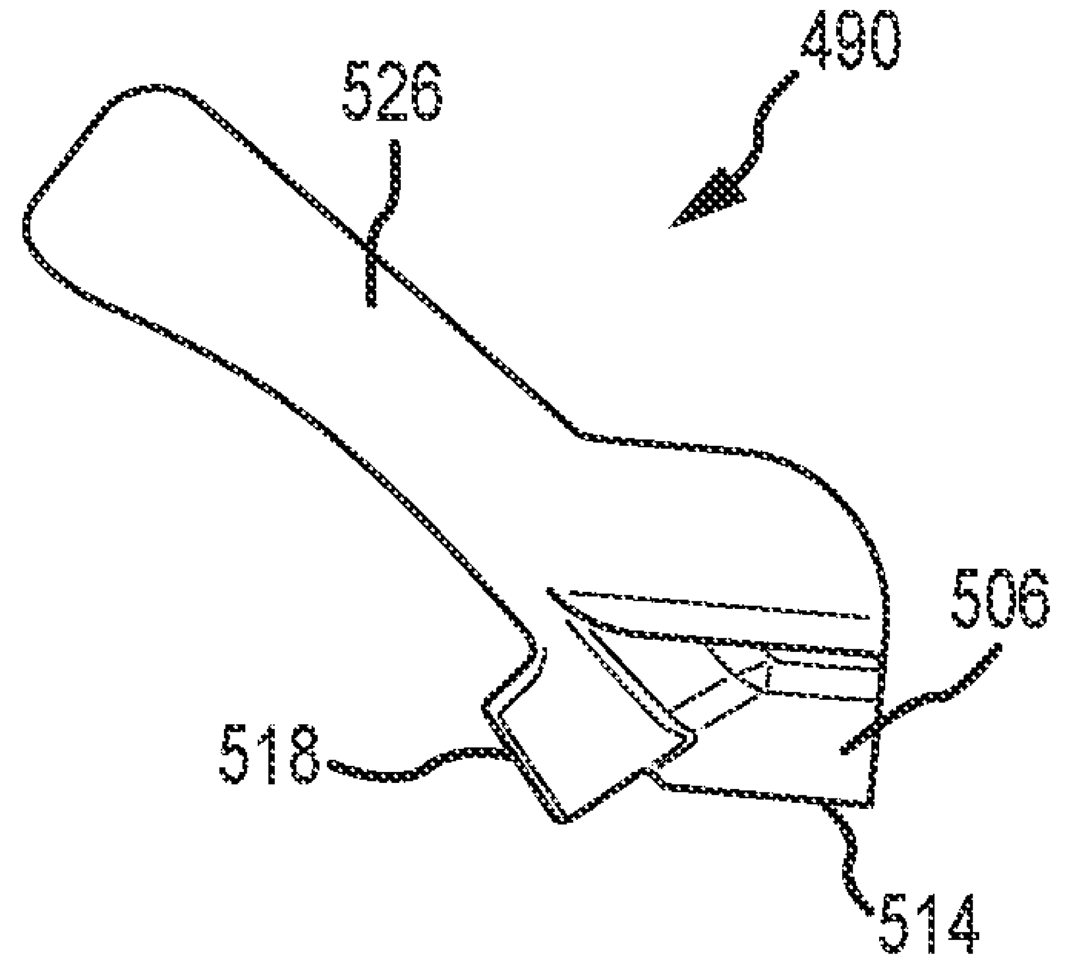
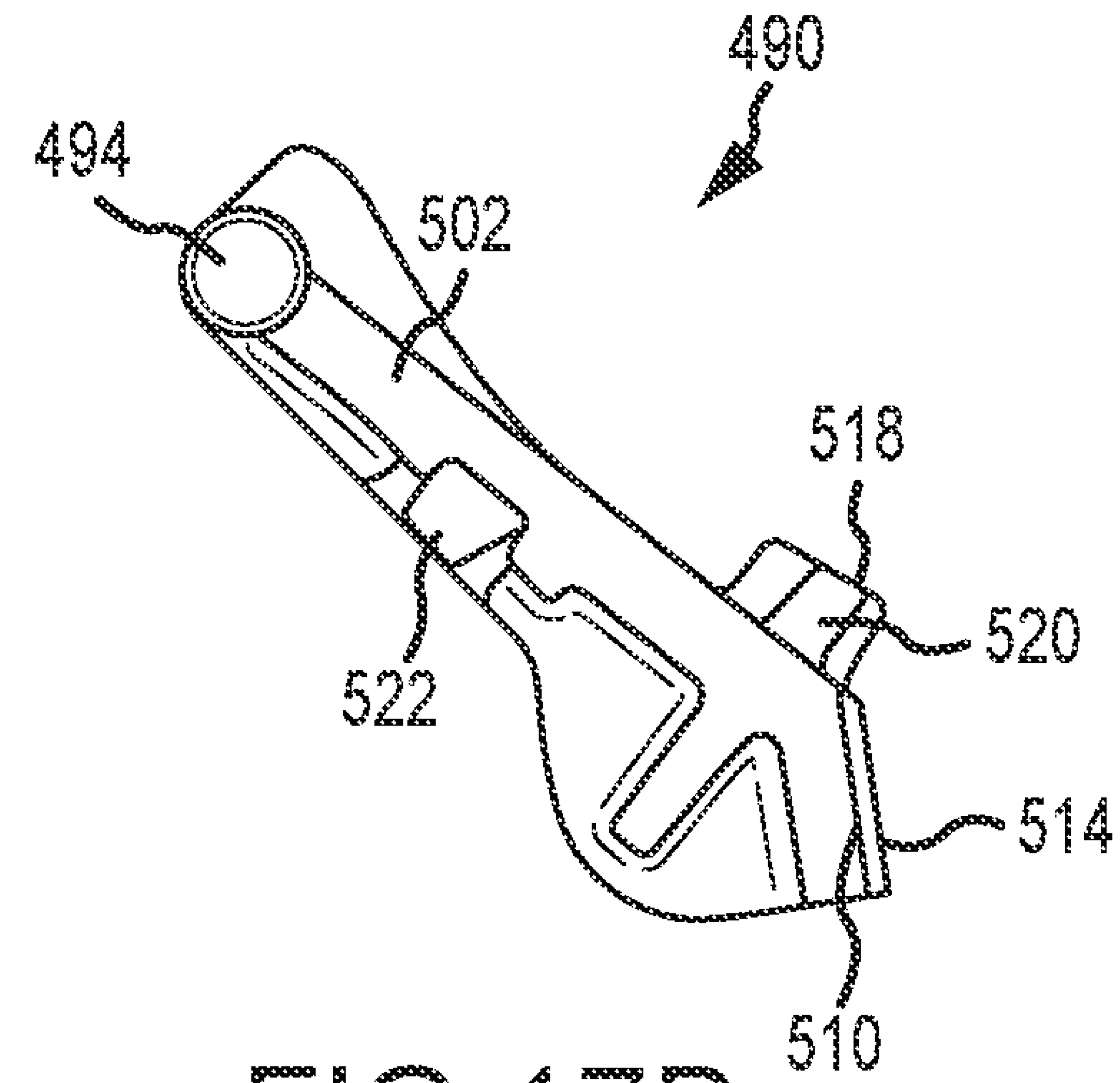


FIG.17A



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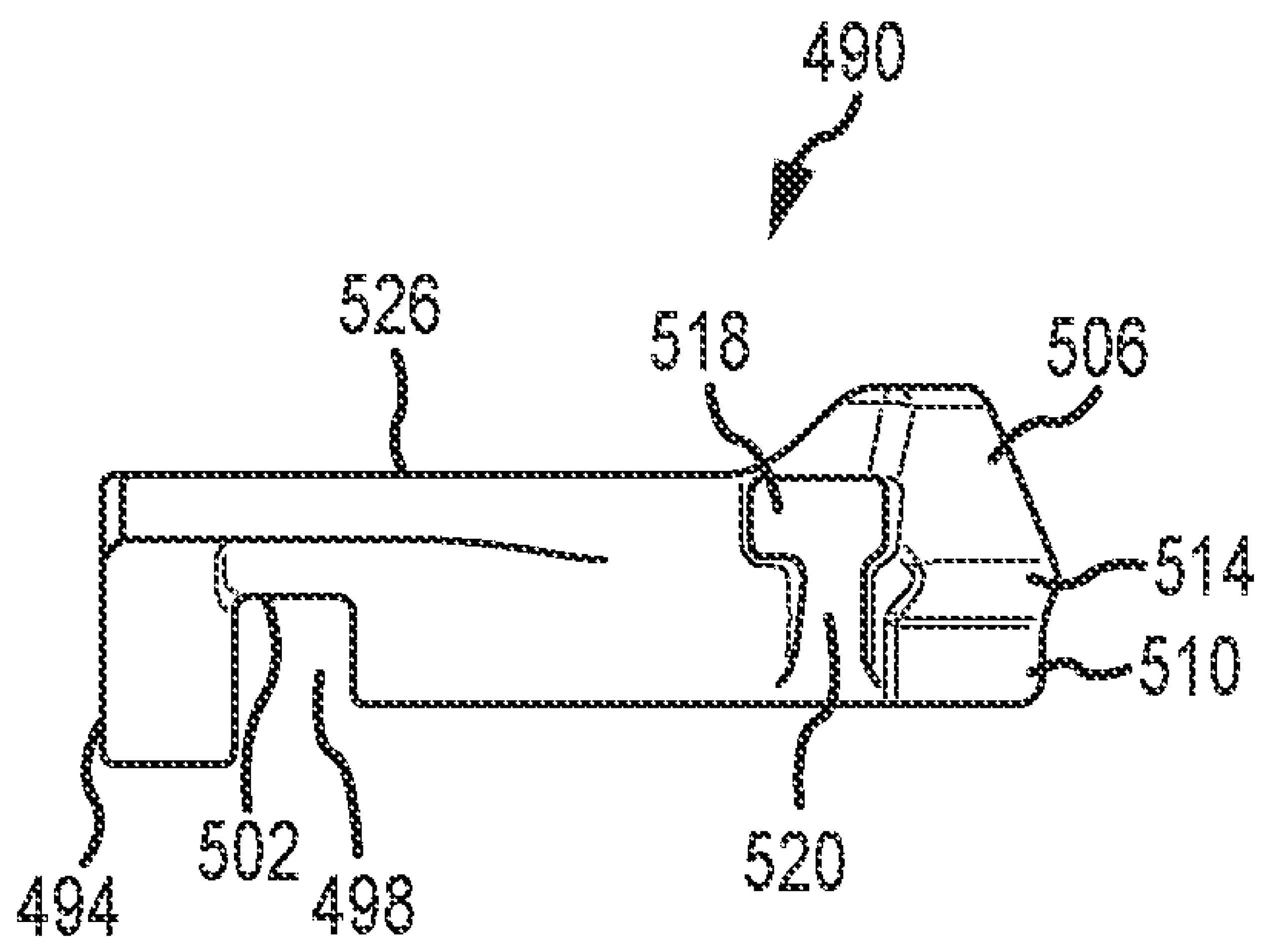

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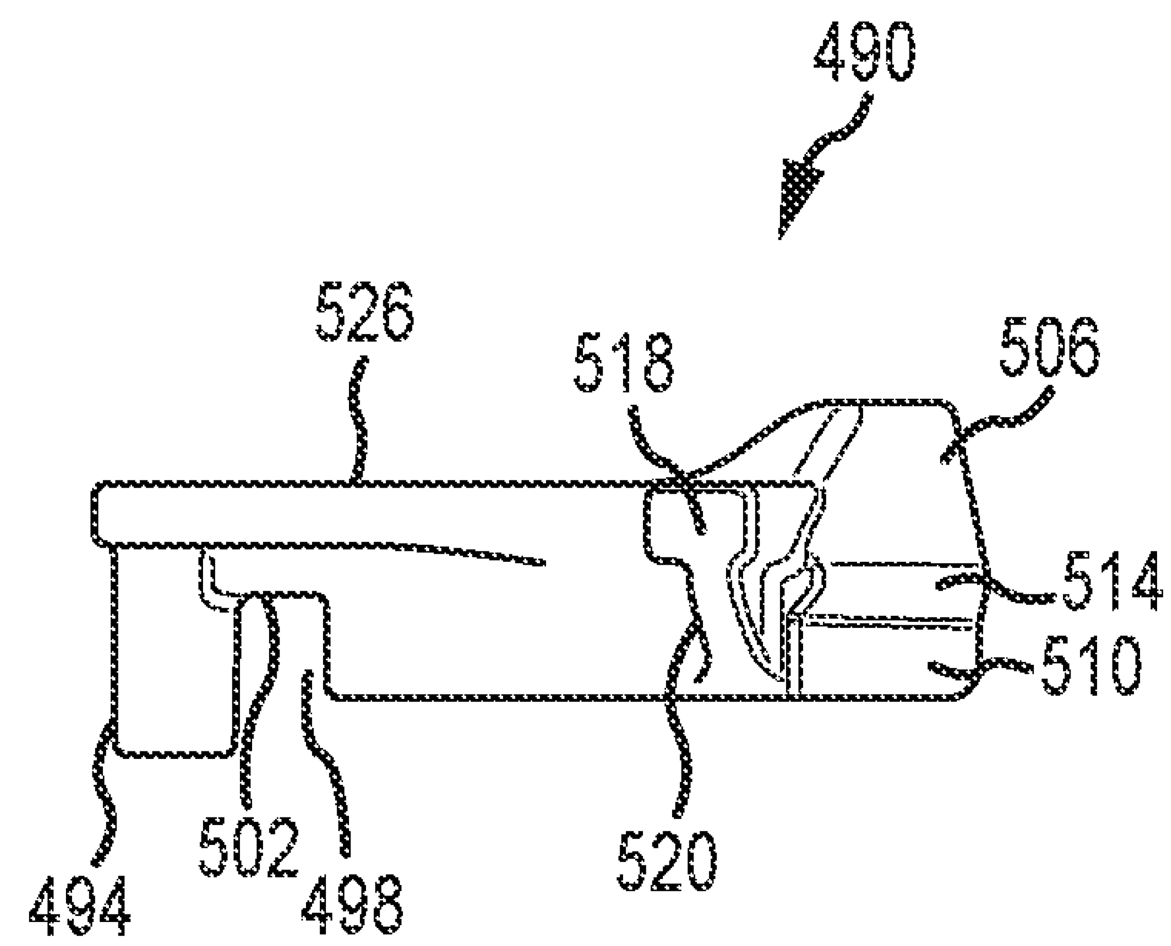


FIG.17D

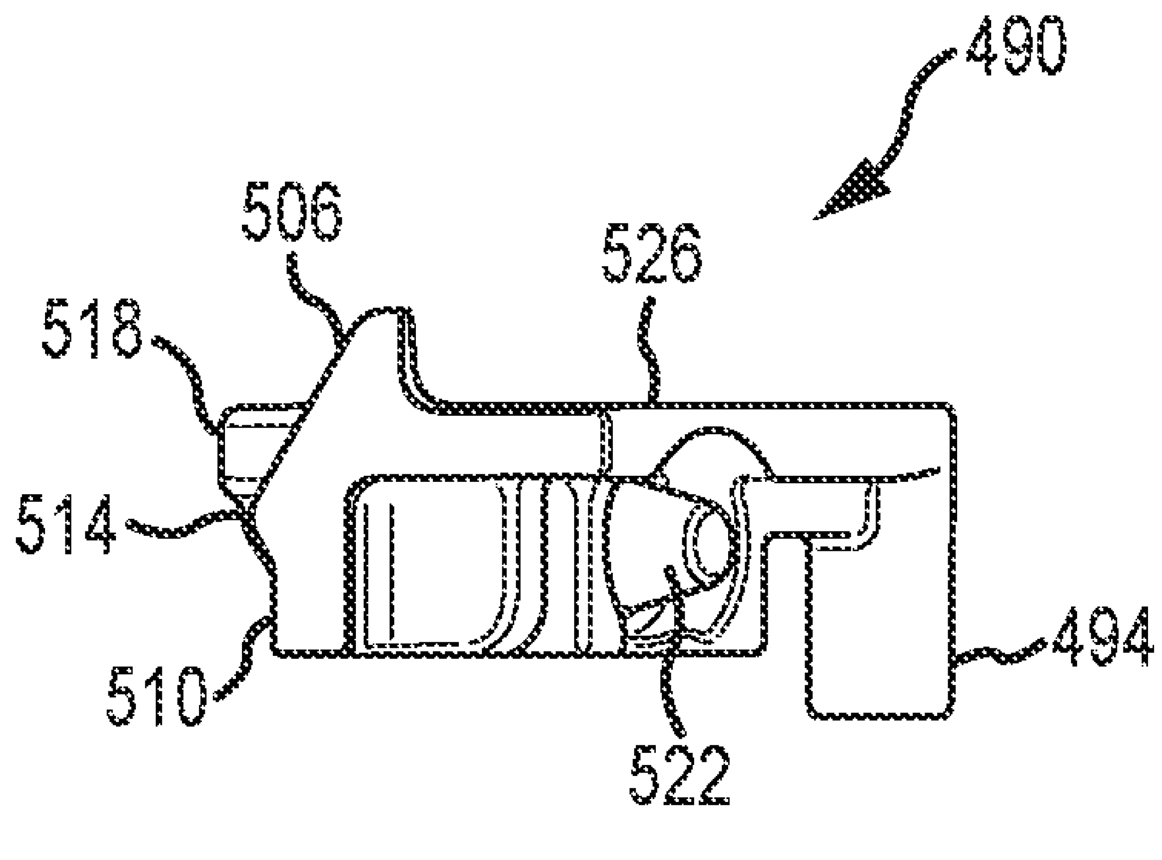


FIG.17E

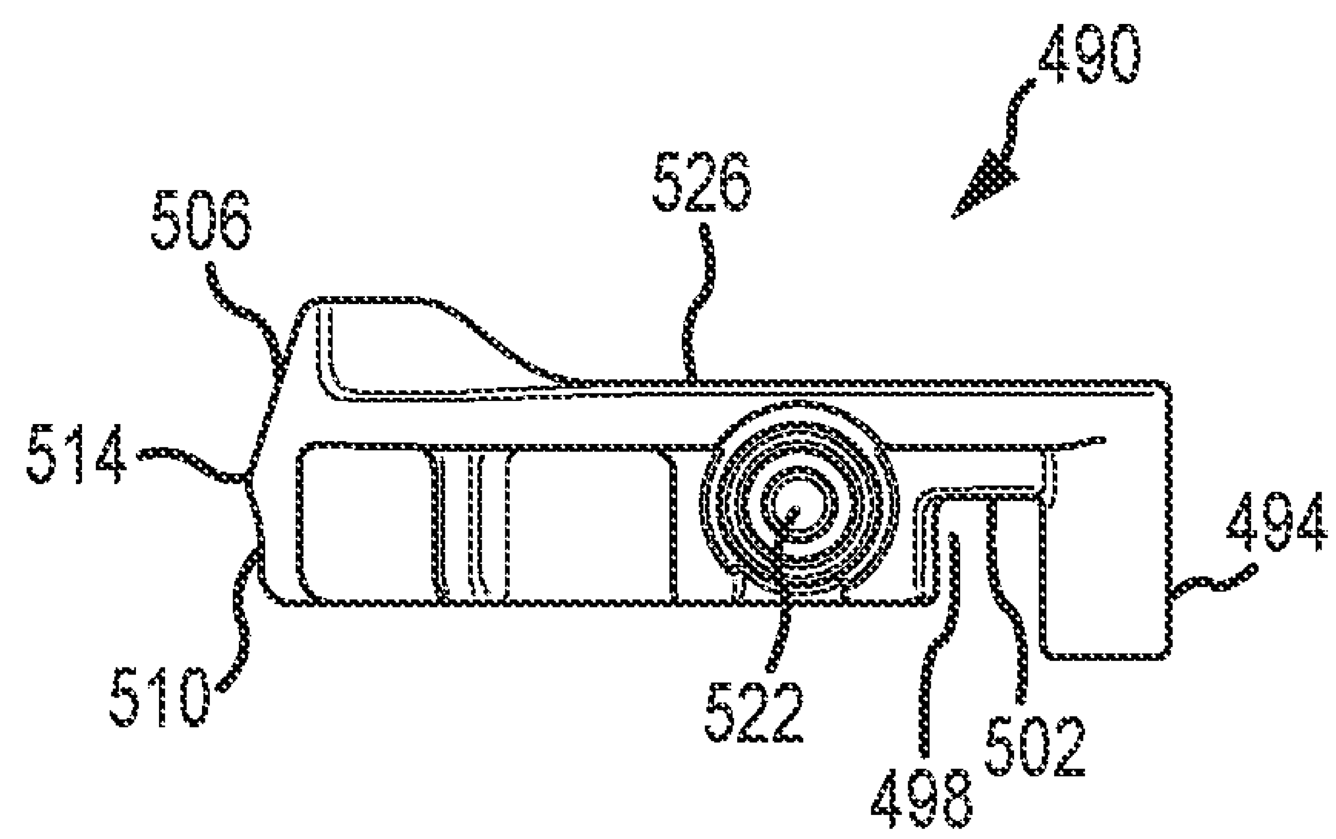


FIG.17F

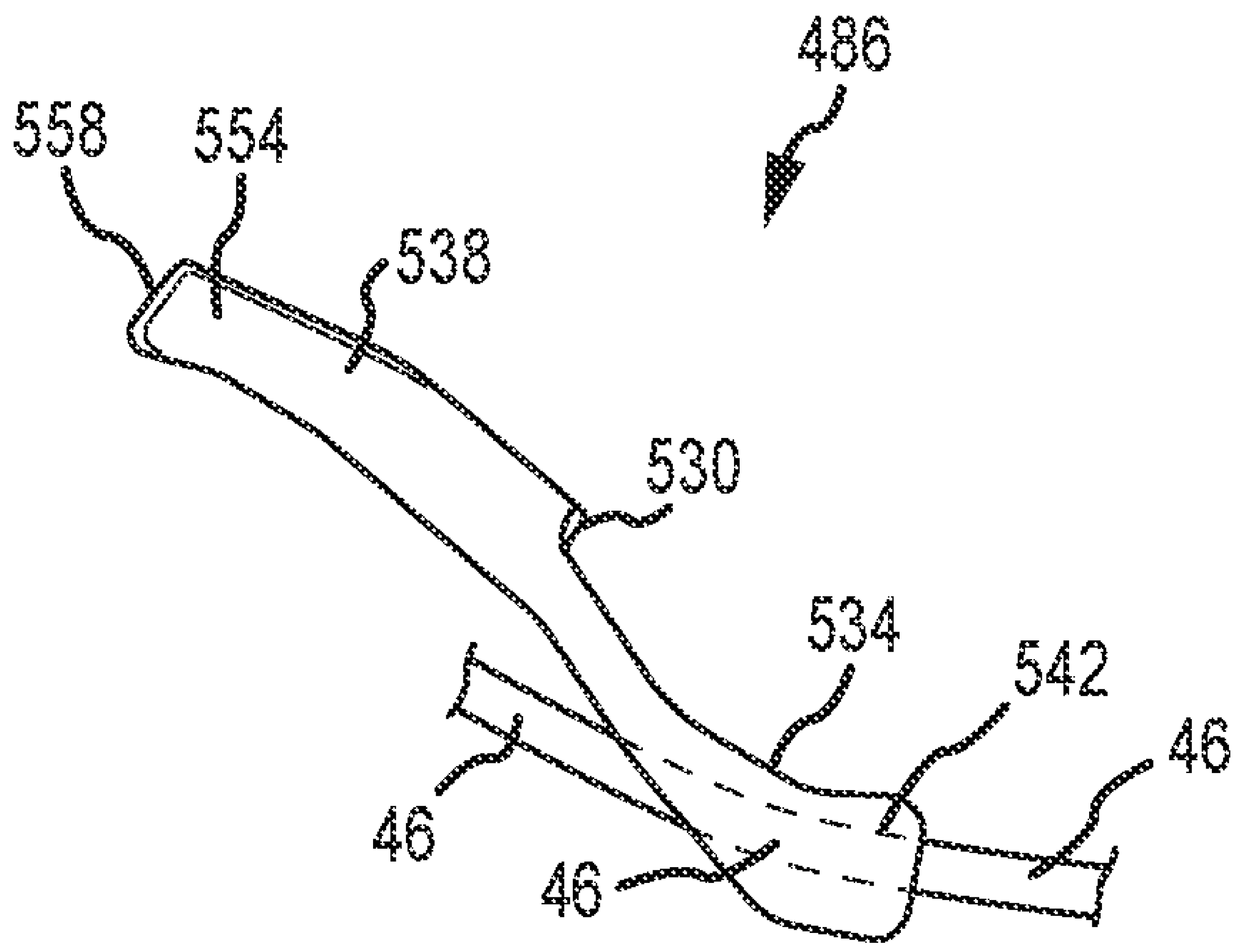
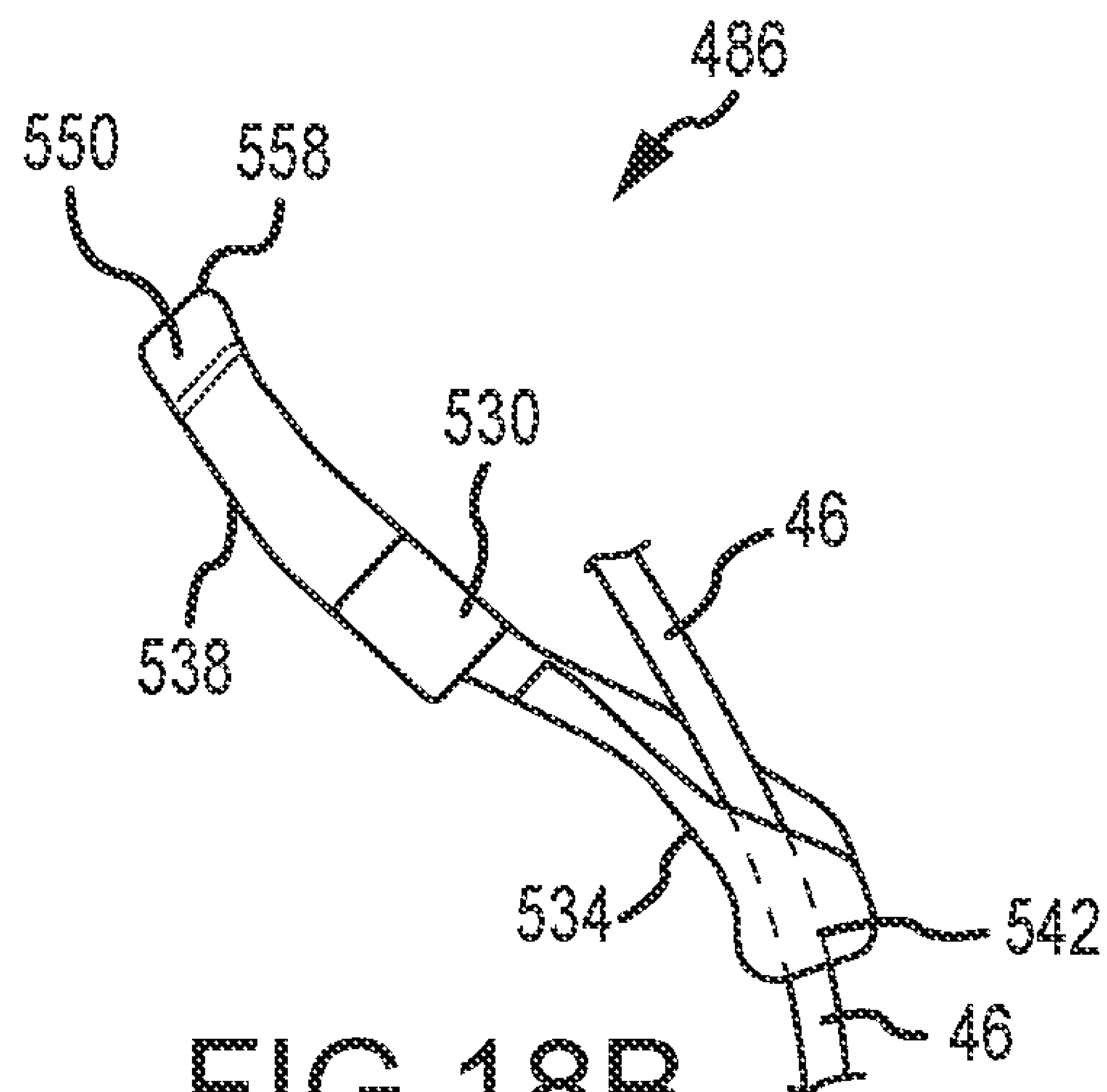


FIG.18A



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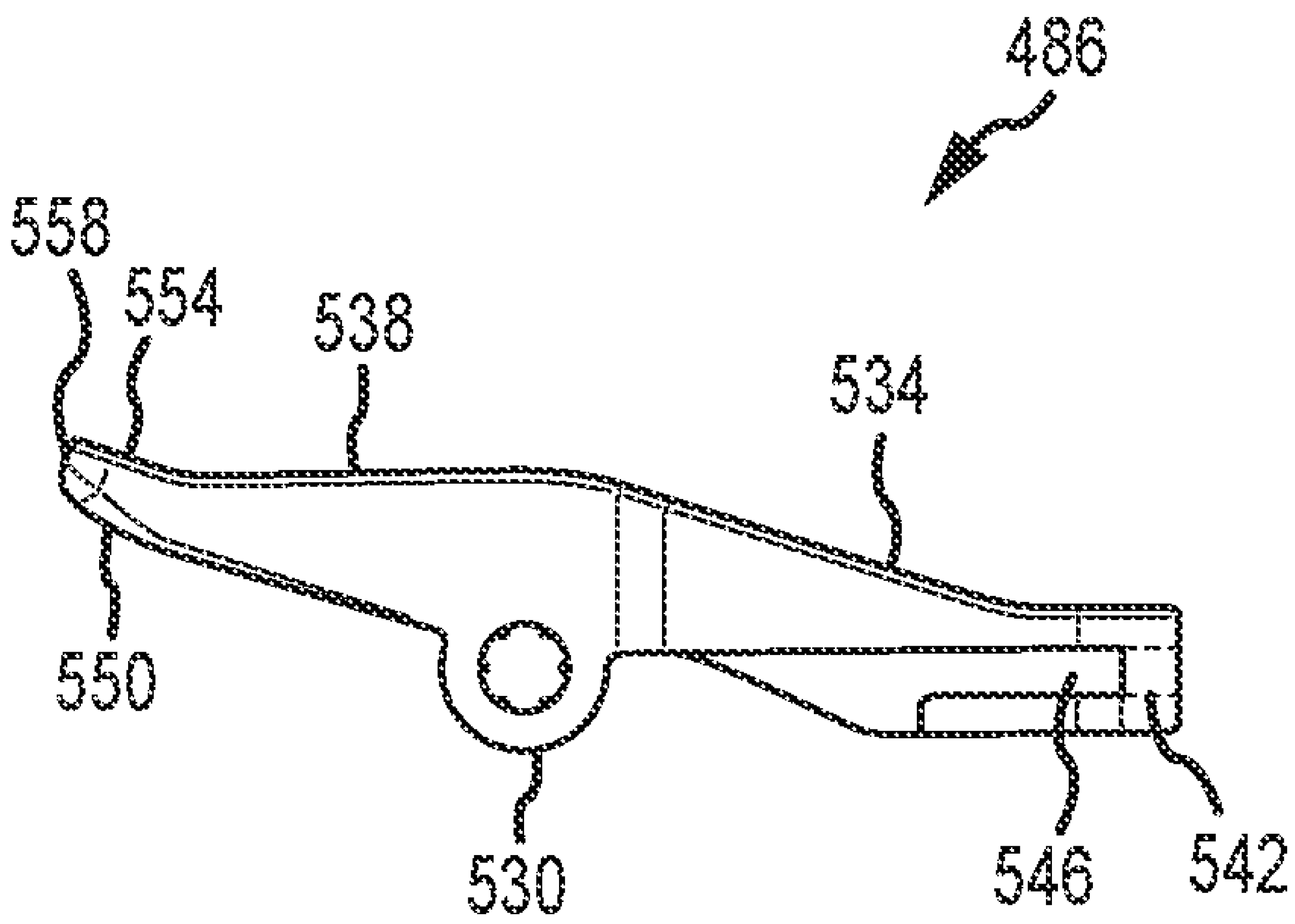

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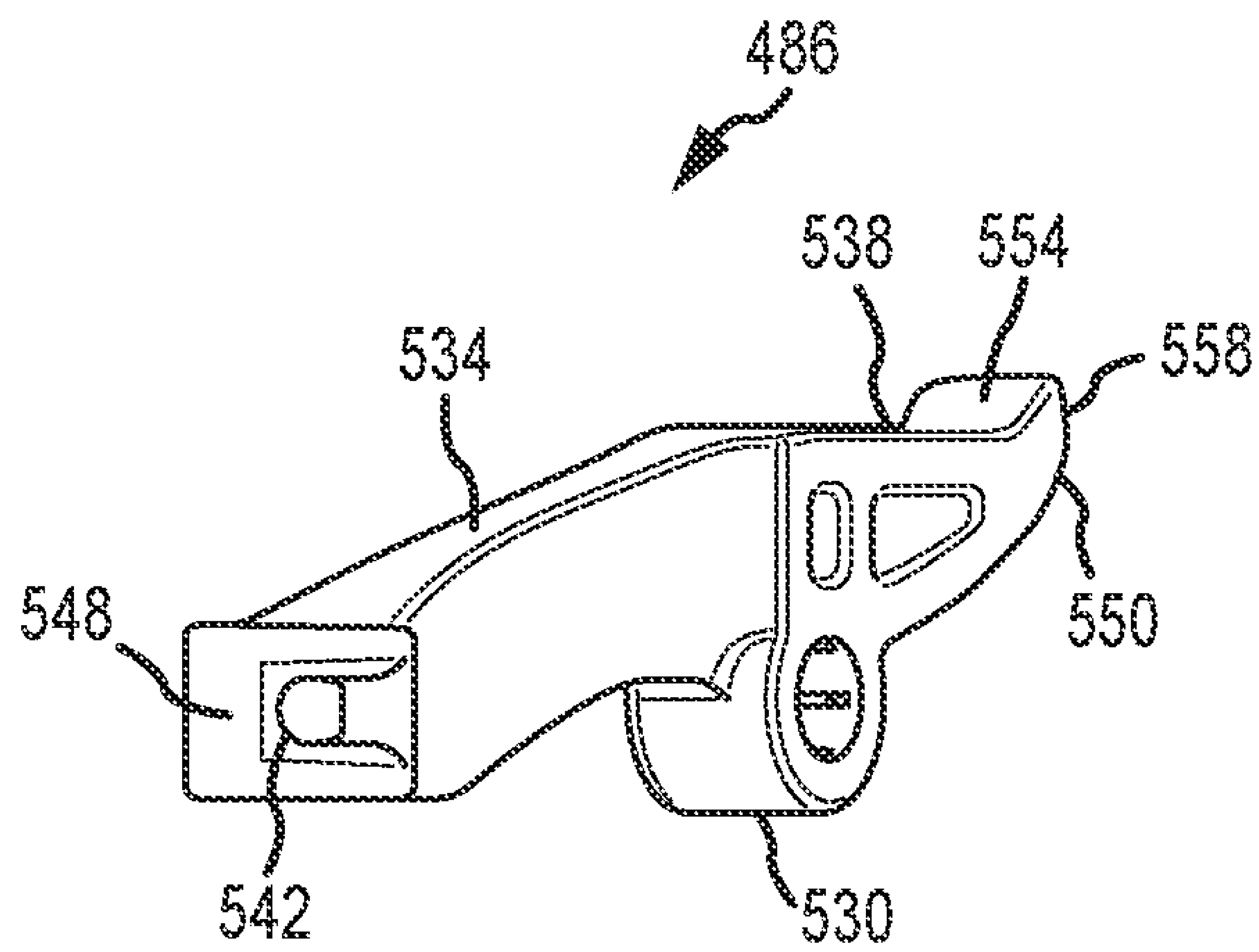

FIG.18D

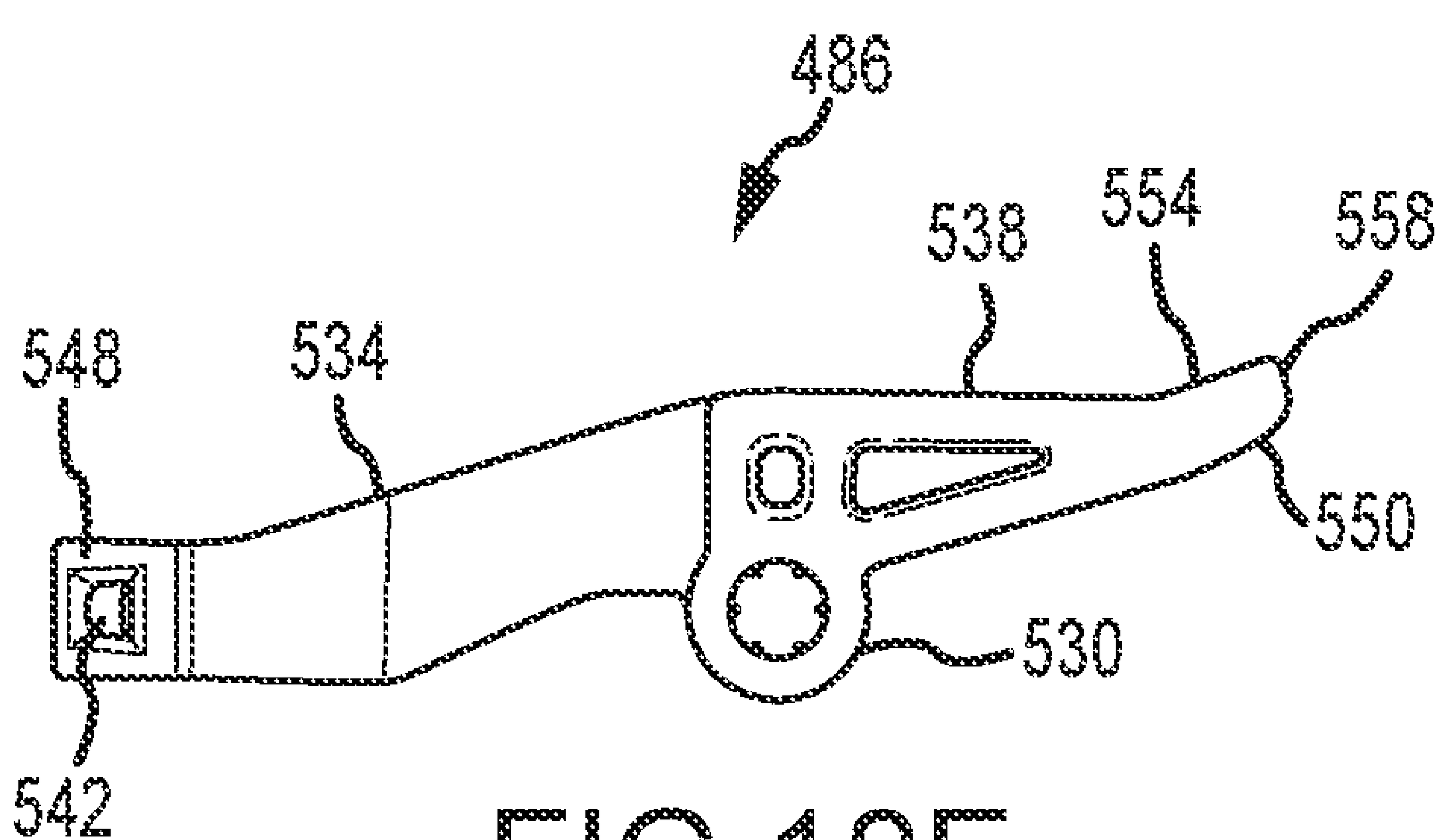

FIG.18E

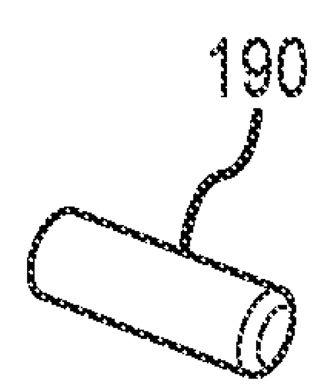

FIG.19

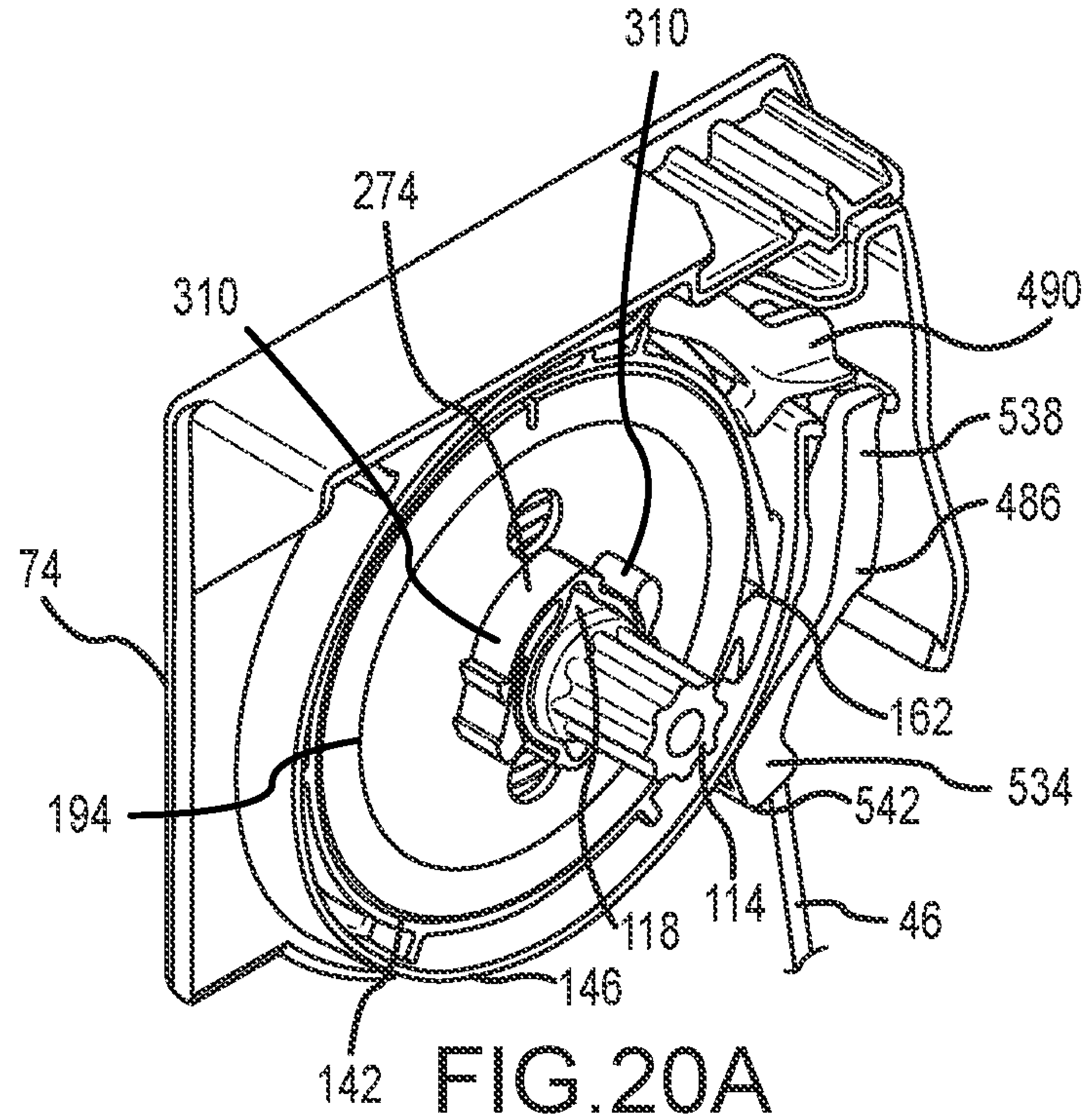

FIG.20A

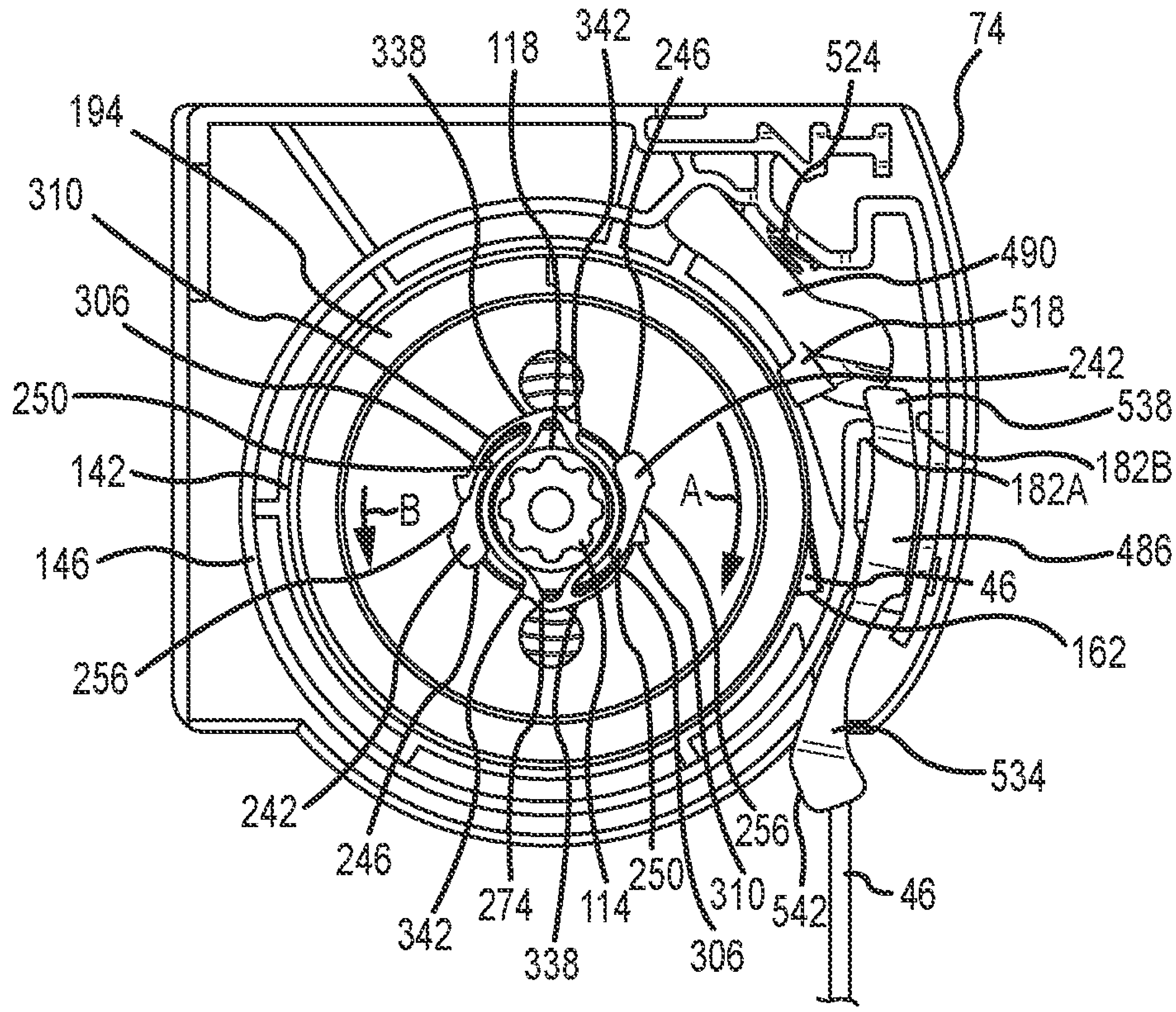

FIG.20B

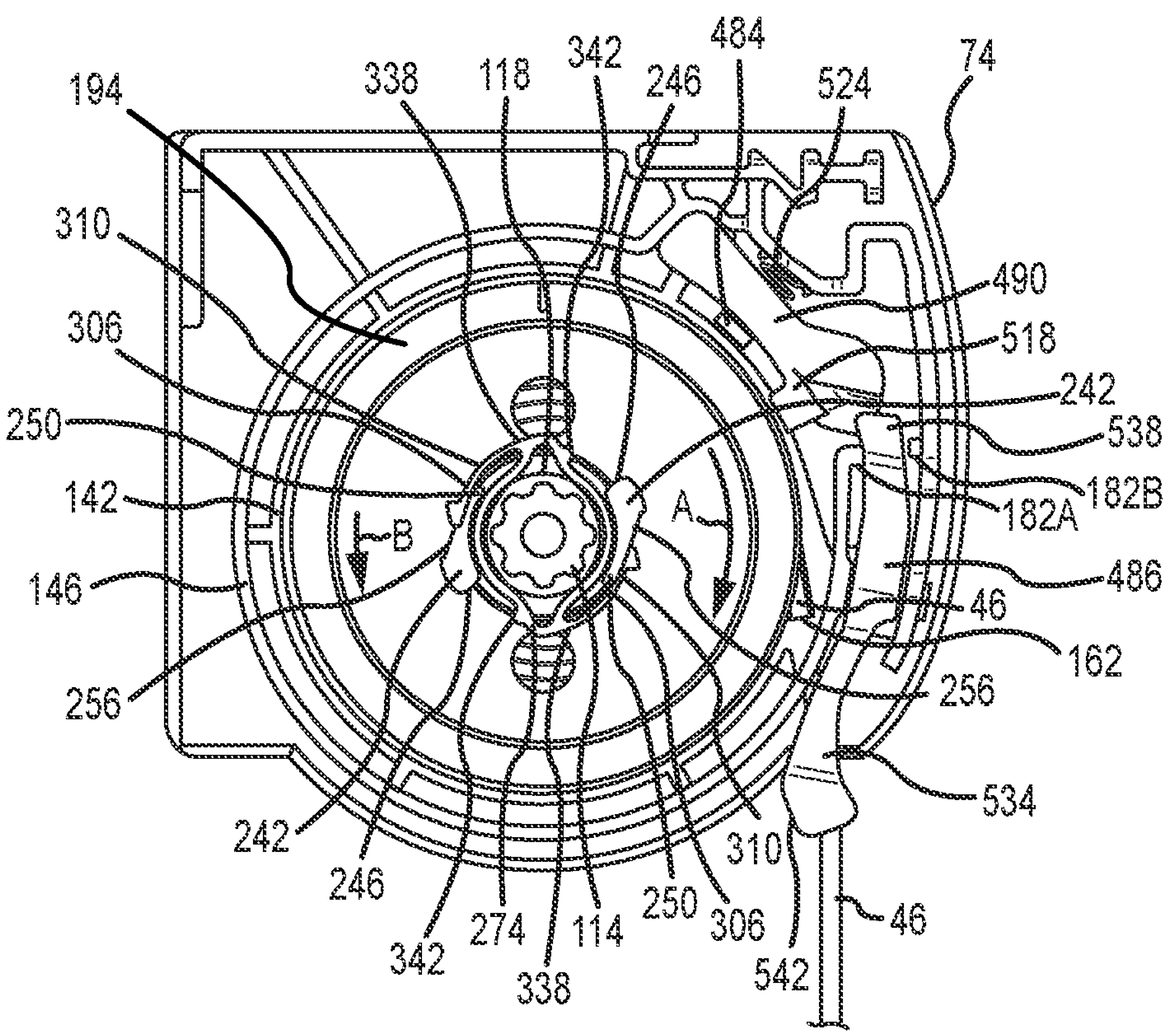
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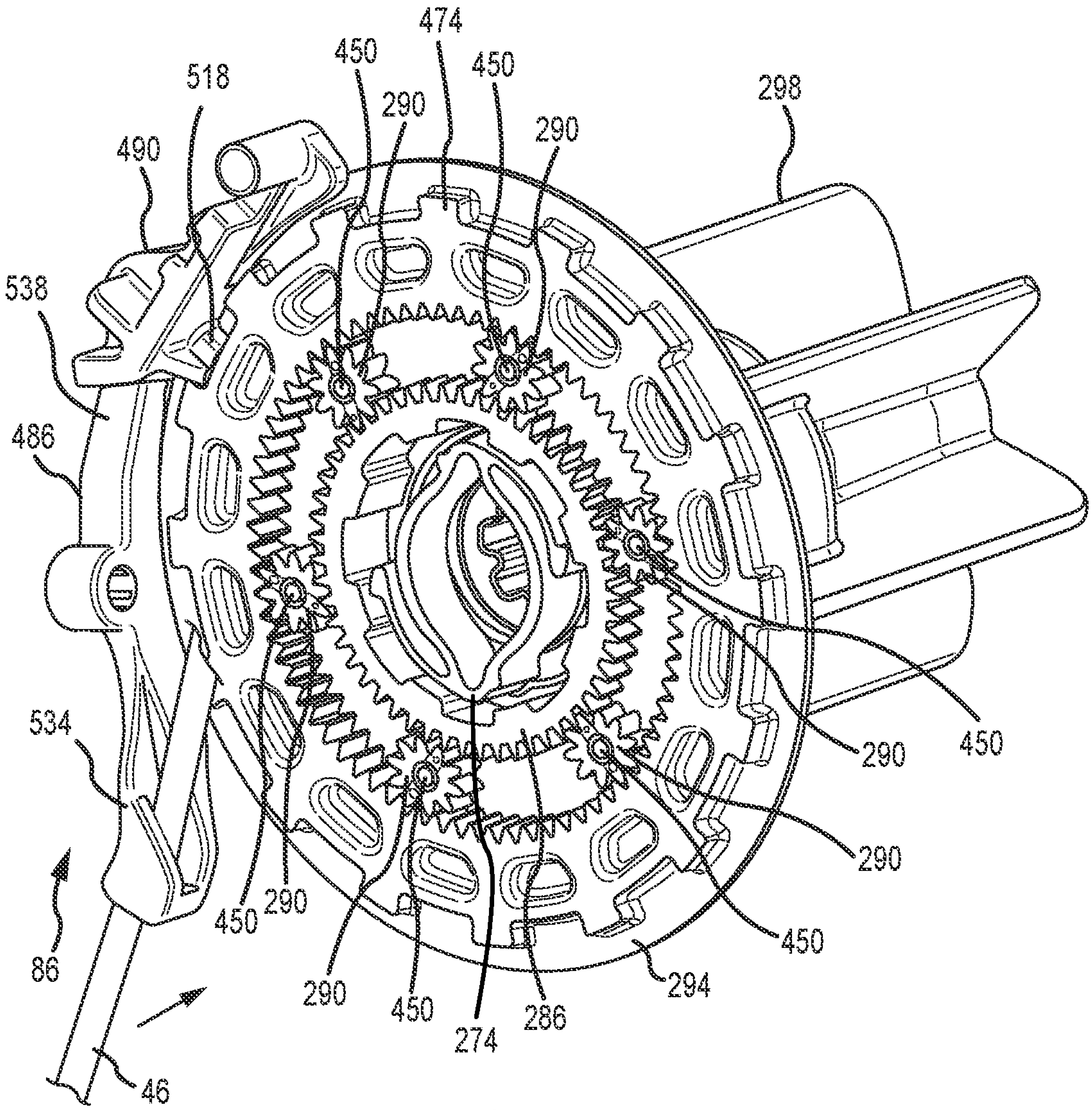
FIG.20C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290
298
490
538
486
450
290
290
534
290
450
290
450
86
290
450
294
450
274
286
46

FIG.21A

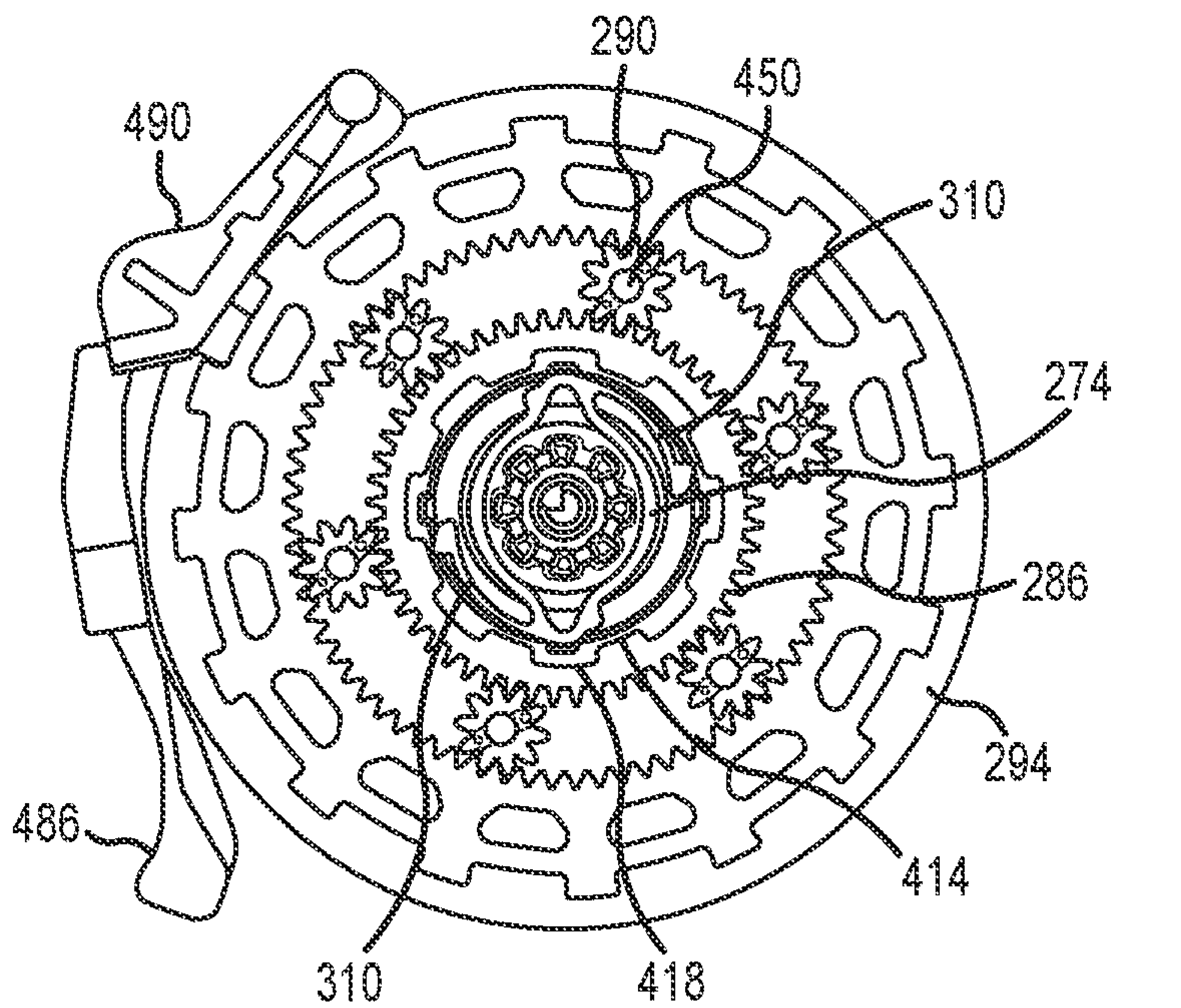

FIG.21B

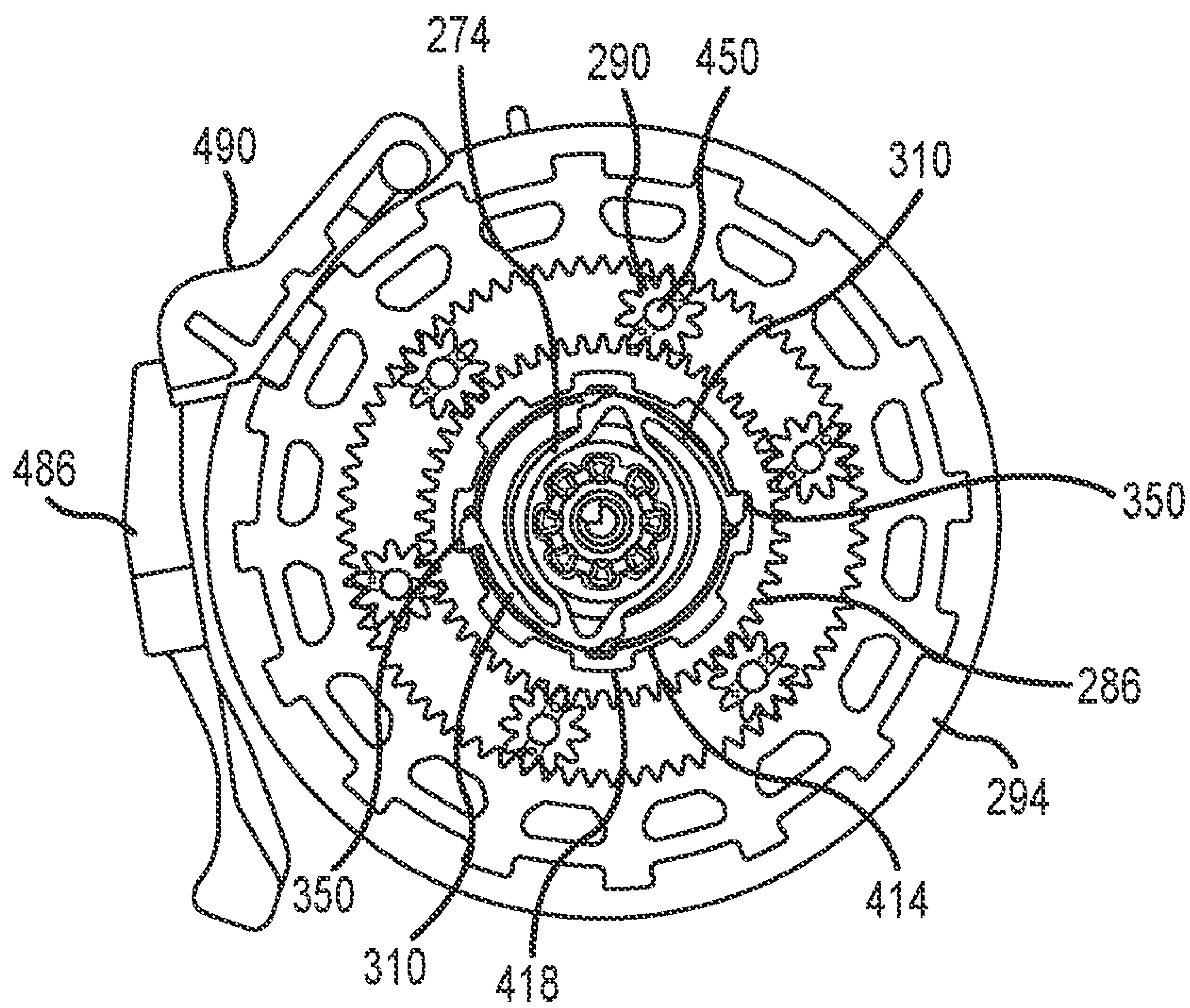

FIG.21C

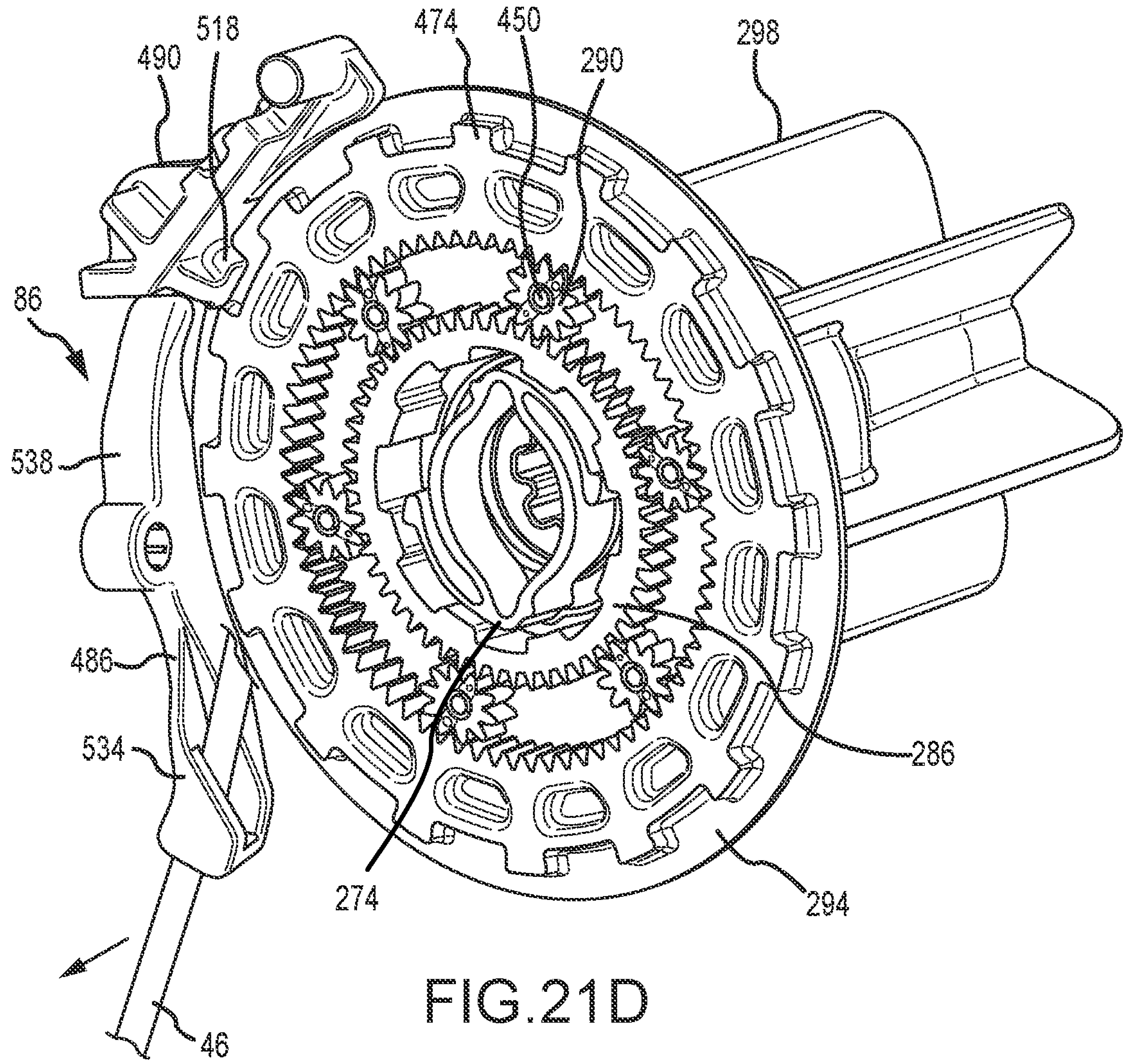

FIG.21D

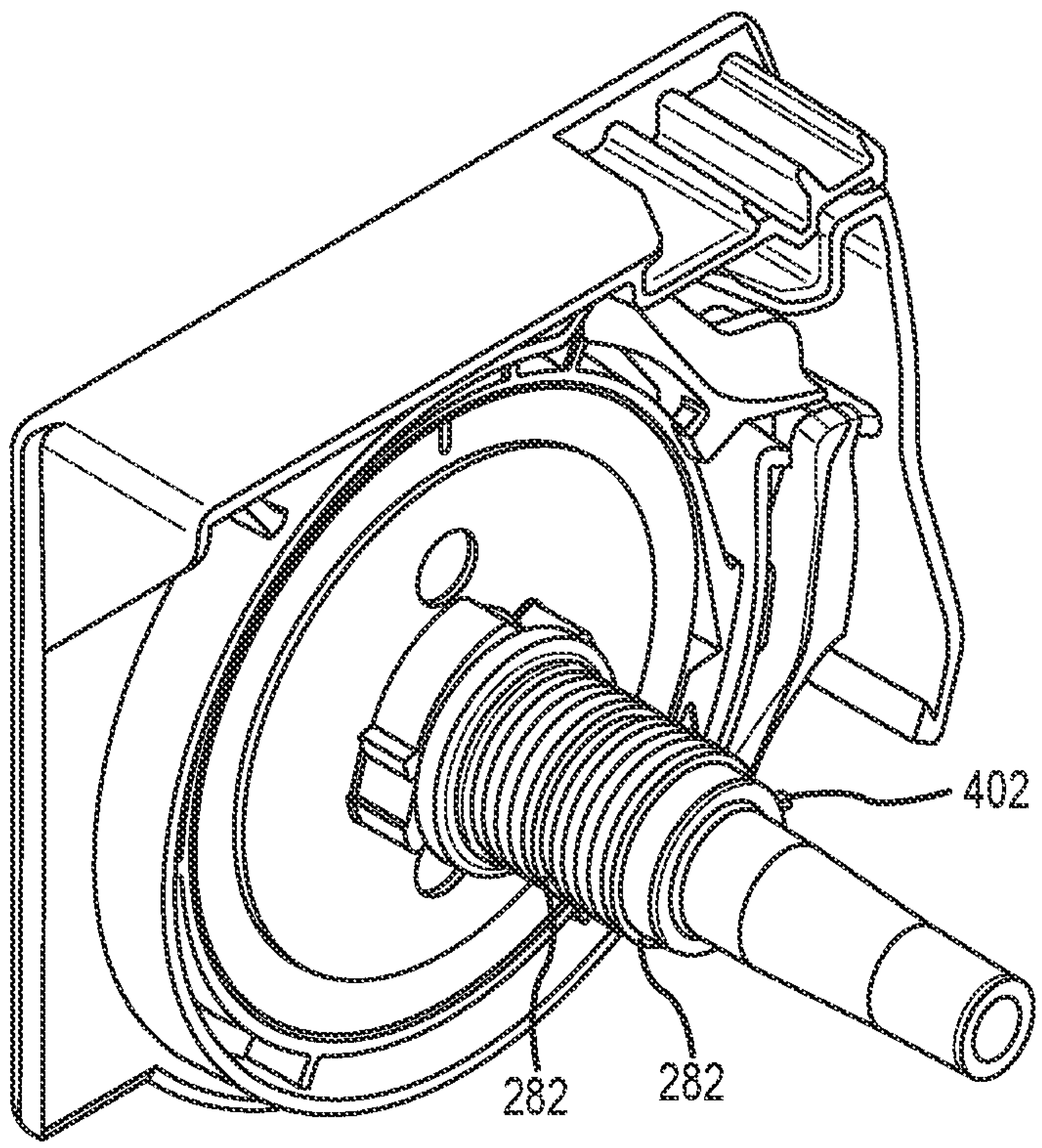

FIG.22A

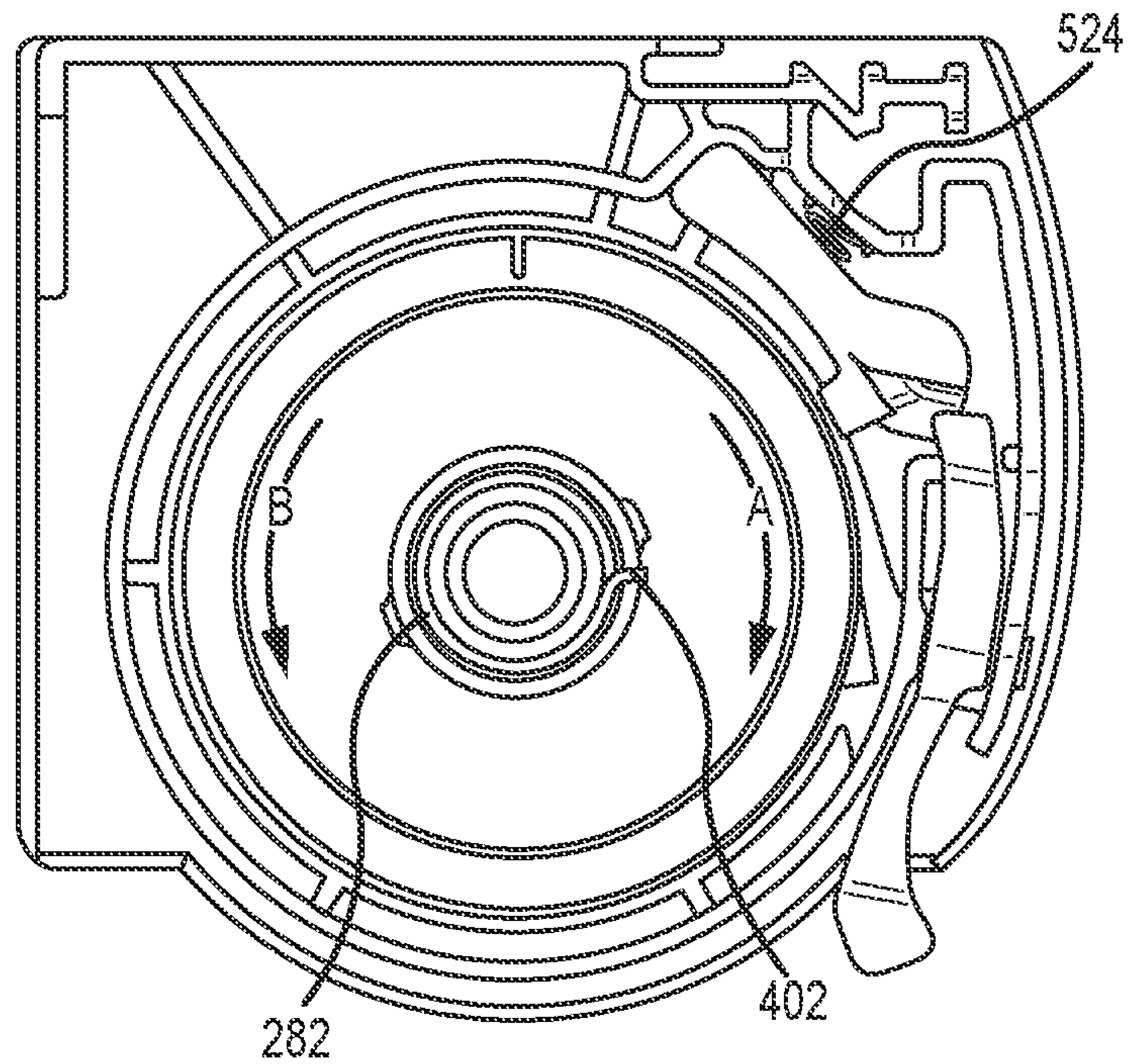

FIG.22B

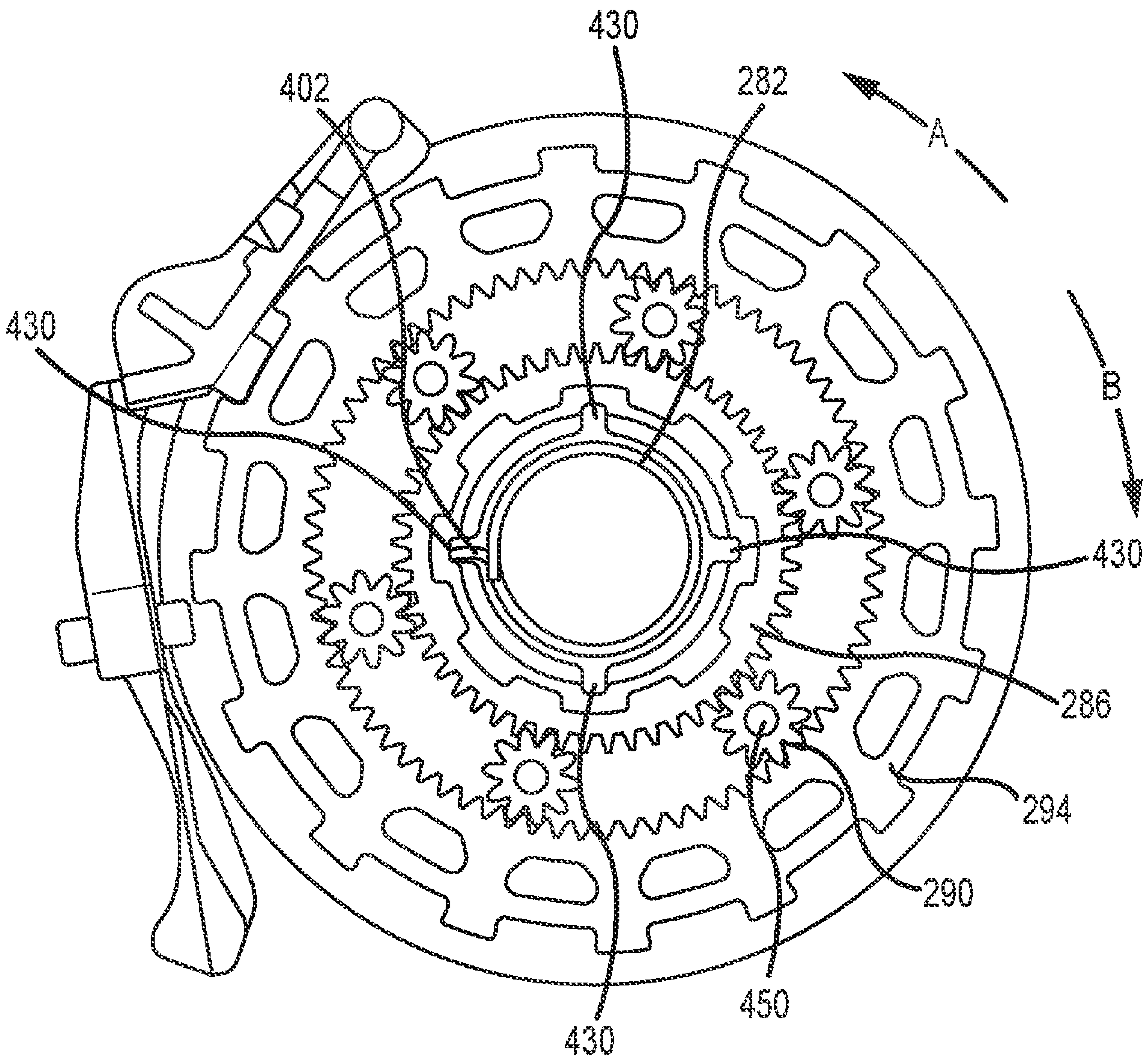

FIG.23

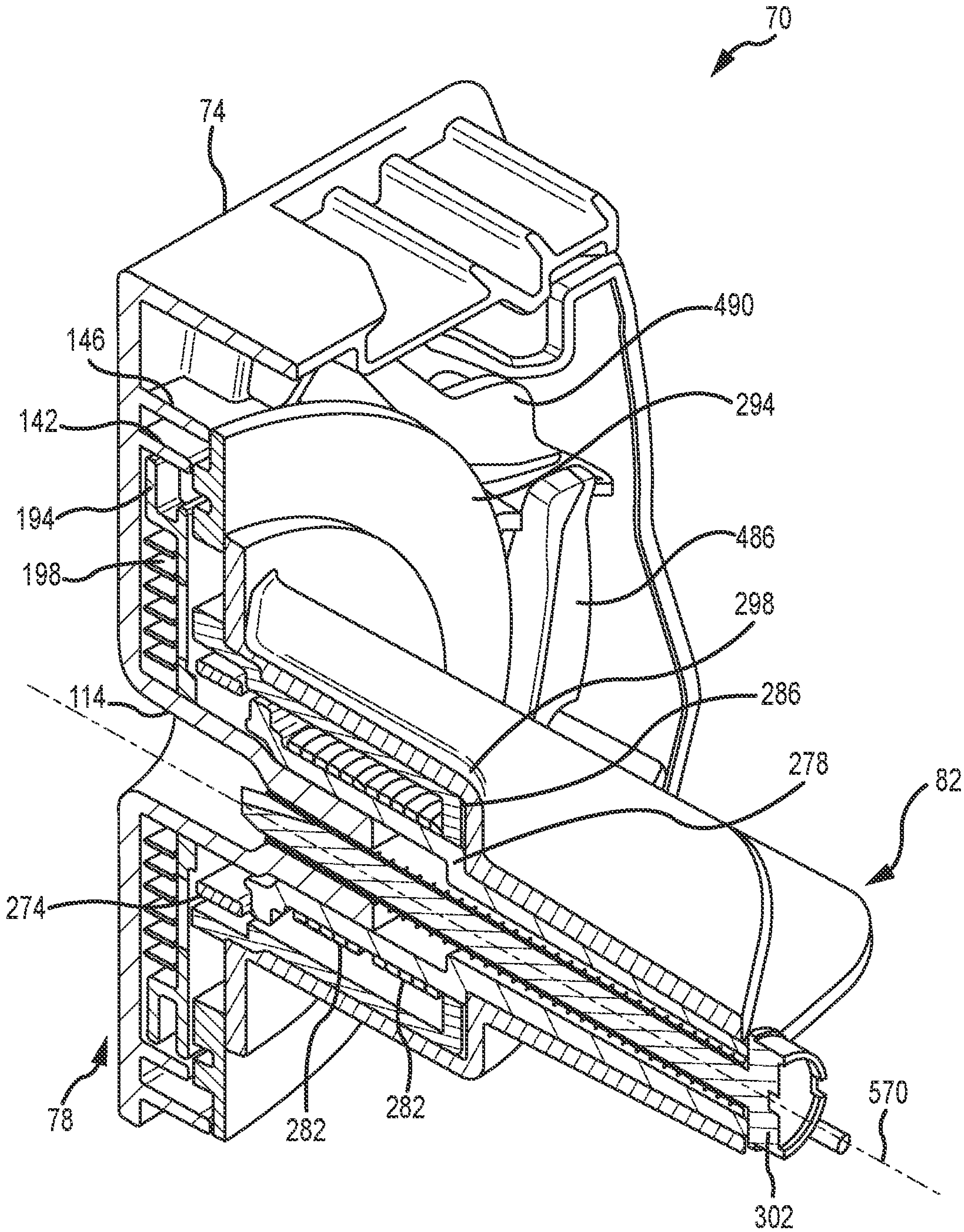
70
74
490
146
294
142
194
486
198
298
114
286
278
82
274
570
78
282
282
302

FIG.24A

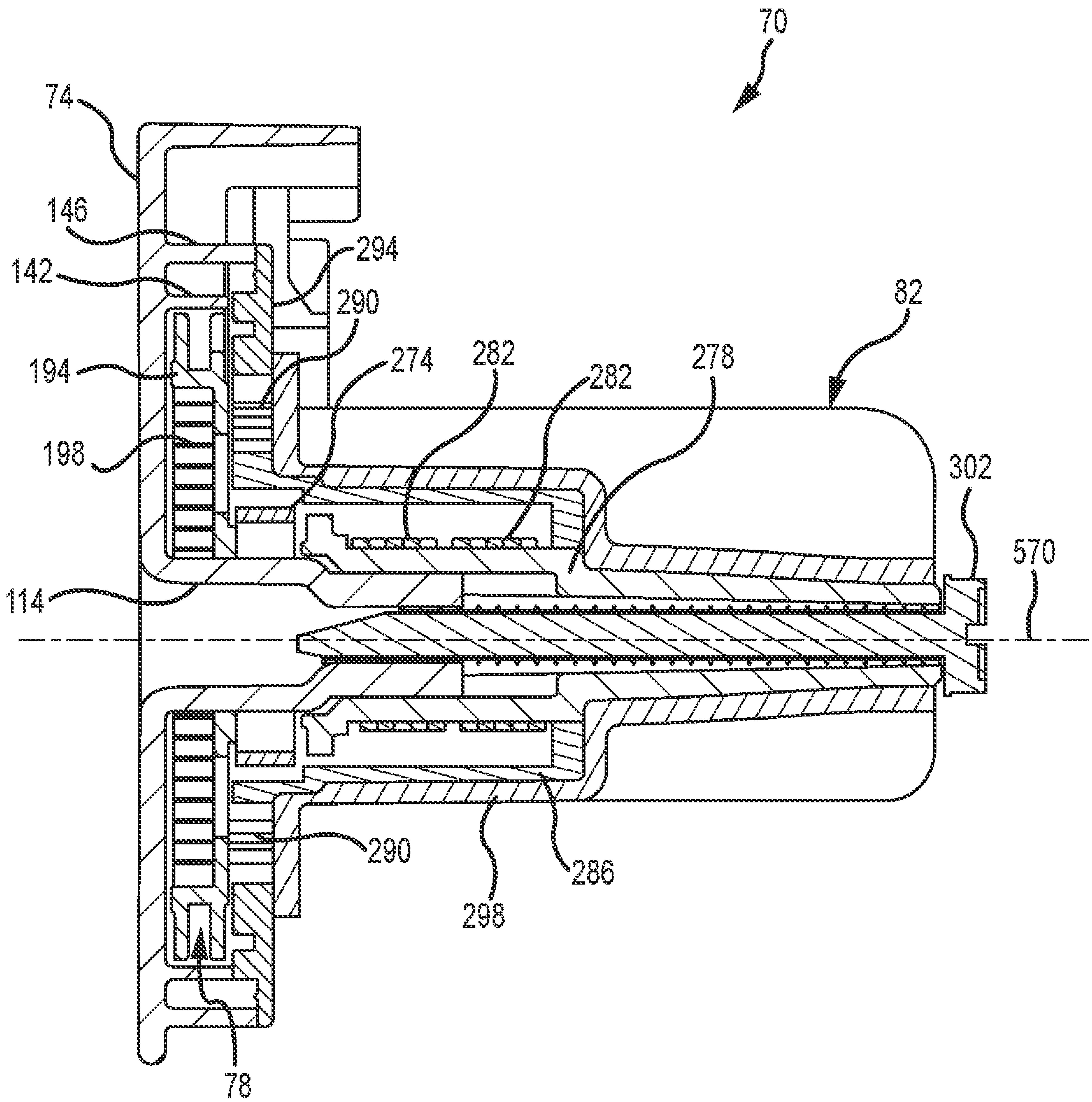
70
74
146
142
194
198
114
294
290
274
282
282
278
82
302
570
290
298
286
78

FIG.24B

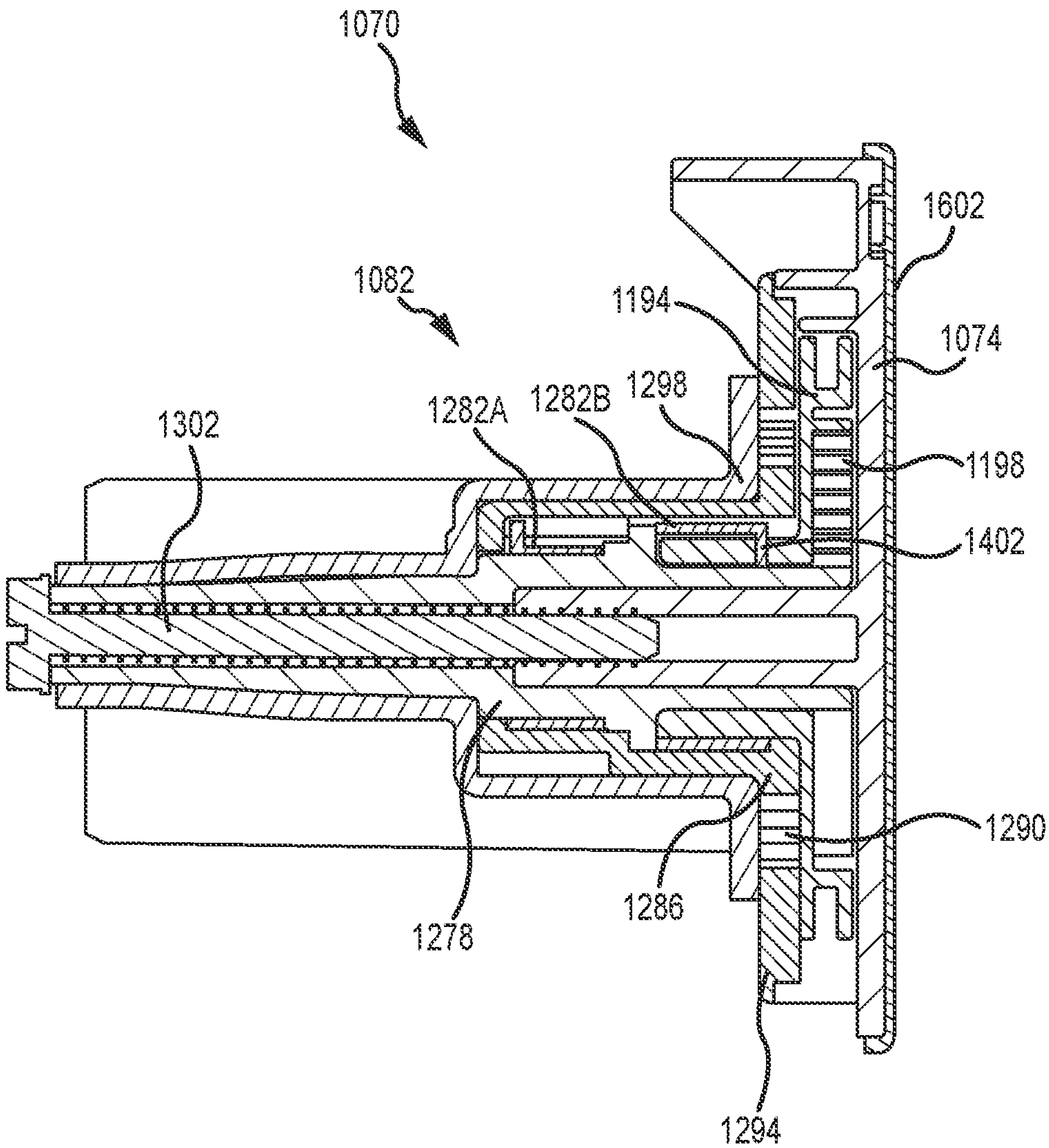
1070
1082
1602
1194
1074
1298
1282A
1282B
1302
1198
1402
1290
1286
1278
1294

FIG.25

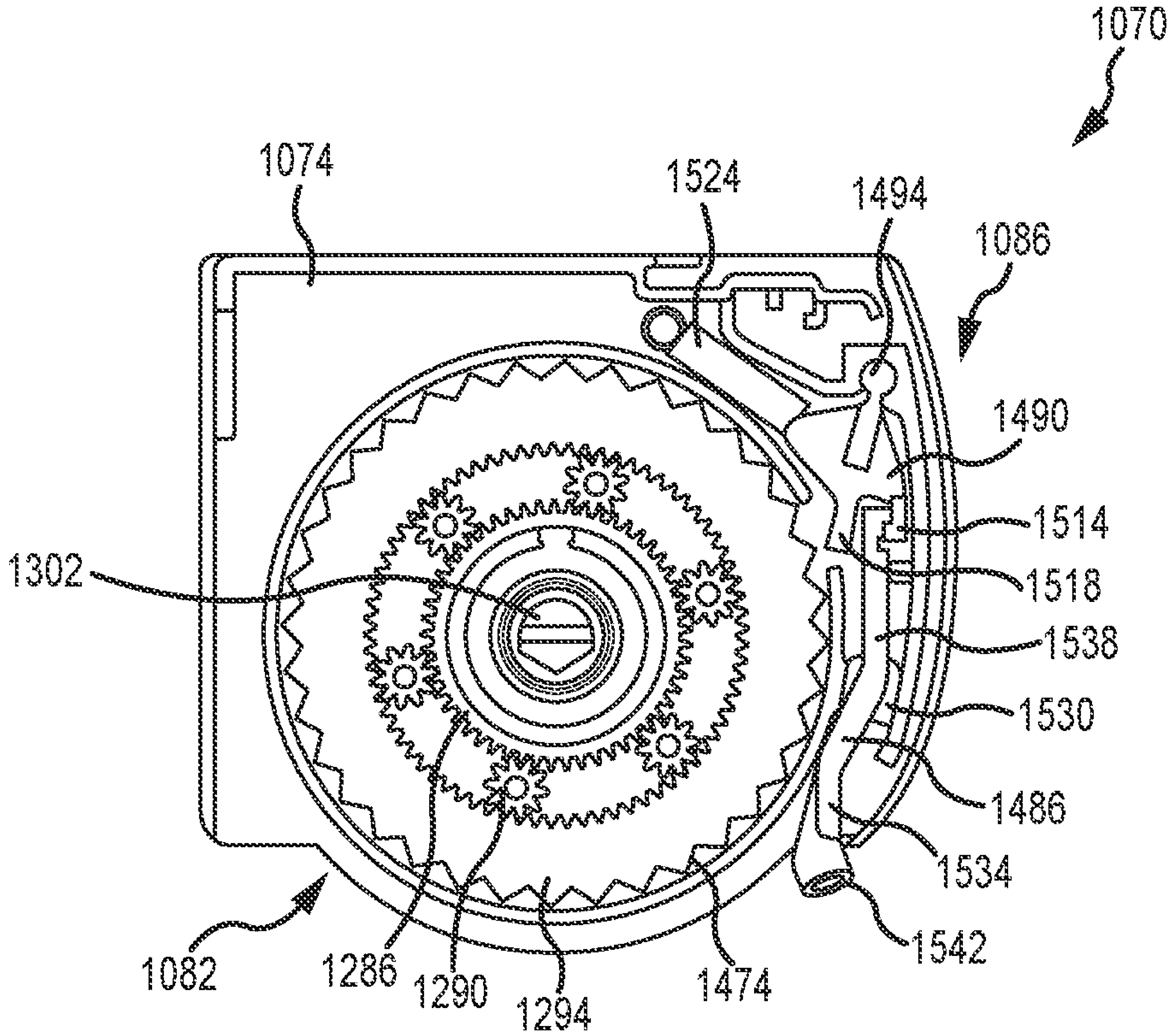

FIG.26A

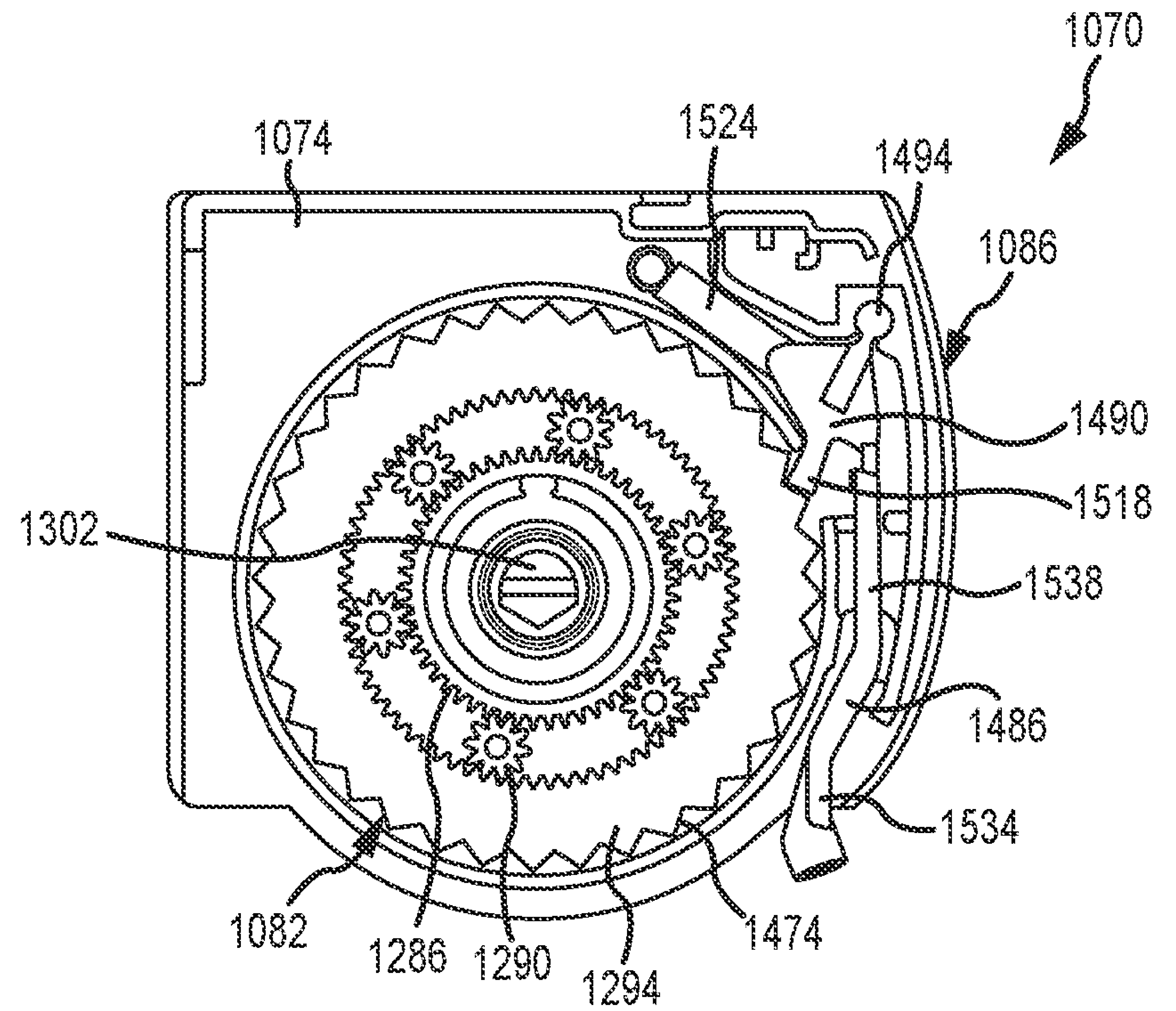

FIG.26B

OPERATING SYSTEM FOR A COVERING FOR AN ARCHITECTURAL OPENING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. patent application Ser. No. 16/987,471, filed Aug. 7, 2020, entitled "Operating System For a Covering For an Architectural Opening", which is a continuation application of U.S. patent application Ser. No. 15/856,121, filed Dec. 28, 2017, now U.S. Pat. No. 10,774,586, entitled "Operating System For a Covering For an Architectural Opening", which is a continuation application of U.S. patent application Ser. No. 14/766,043, filed Aug. 5, 2015, now U.S. Pat. No. 9,890,588, entitled "Operating System For a Covering For an Architectural Opening", which application is the national stage application of International Patent Application No. PCT/US2013/030176, filed Mar. 11, 2013, entitled "Operating System For a Covering For an Architectural Opening', which are hereby incorporated by reference herein in their entirety for all purposes.

FIELD OF THE DISCLOSURE

The present disclosure relates generally to coverings for architectural openings, and more particularly to methods and apparatus for operating a covering for an architectural opening.

BACKGROUND

Coverings for architectural openings, such as windows, doors, archways, and the like, have taken numerous forms for many years. Some conventional coverings include a retractable shade portion that is movable between an extended position and a retracted position. In the extended position, the shade portion of the covering may be positioned across the opening. In the retracted position, the shade portion of the covering may be positioned adjacent one or more sides of the opening.

To move the shade portion of the covering between the extended and retracted positions, some coverings include a roller rotatably associated with a fixed end rail of the covering. Rotation of the roller in a first direction retracts the shade portion of the covering to a position adjacent one or more sides of the opening, and rotation of the roller in a second, opposite direction extends the shade portion across the opening. The roller generally extends between two opposing end caps, and the shade portion of the covering may wrap around the roller or be gathered or stacked adjacent to the roller. For example, some retractable coverings include a flexible shade or shade material suspended from a roller. The shade material can either be wrapped about the roller to retract the shade material or unwrapped from the roller to extend the shade material. As another example, some retractable coverings, such as Venetian blinds, include a plurality of slats that are raised or lowered as lift cords are wrapped about or unwrapped from a rotatable roller. Regardless of the form of the retractable covering, rotation of the roller generally causes movement of the shade portion of the covering. To actuate movement of the roller, and thus the shade portion of the covering, an operating system may be operably coupled to the roller.

SUMMARY

Examples of the disclosure may include a covering for an architectural opening. In one example, the covering may

include a roller, a shade, and an operating system. The roller may be rotatable about a longitudinal axis in an extension direction and a retraction direction. The shade may be associated with the roller. The operating system may be operably associated with the roller. The operating system may include a base, a drive mechanism associated with the base to provide an input torque, a transmission associated with the drive mechanism to selectively transmit the input torque to the roller, and an actuator arm operably associated with the base to indirectly set a rotation direction of the roller. The actuator arm may be movable about a first axis that is generally transverse to the longitudinal axis of the roller.

The covering may further include an engagement arm operably associated with the base and movable about a second axis. The second axis may be generally parallel to the longitudinal axis of the roller. The second axis may be generally transverse to the first axis. The engagement arm may selectively engage the transmission to set the rotation direction of the roller. The transmission may include a ring gear, and the engagement arm may selectively engage the ring gear to set the rotation direction of the roller. The operating system may further include a biasing element configured to bias the engagement arm into engagement with the transmission. To set the rotation direction of the roller to the extension direction, the actuator arm may contact the engagement arm to disengage the engagement arm from the transmission. The engagement arm may include a detent configured to retain the actuator arm in a position associated with the extension direction. The drive mechanism may include a single operating element. The single operating element may be operably associated with the actuator arm so that select movement of the single operating element moves the actuator arm. The shade may be wrappable about the roller. The drive mechanism may be motorized. When the actuator arm indirectly sets the rotation direction of the roller to the extension direction, the shade may extend automatically under the influence of gravity without further action by an operator.

In another example, the covering may include a rotatable roller, a shade associated with the roller, and an operating system operably associated with the roller. The operating system may include a base, a drive mechanism associated with the base to provide an input torque, a transmission associated with the drive mechanism to selectively transmit the input torque to the roller, an engagement arm movably associated with the base and selectively engageable with the transmission to set a rotation direction of the roller, and an actuator arm operably associated with the base and the engagement arm to move the engagement arm relative to the transmission. The actuator arm may be movable about a first axis, and the engagement arm may be movable about a second axis that is generally transverse to the first axis.

The roller may be rotatable about a longitudinal axis. The first axis may be generally transverse to the longitudinal axis of the roller. The second axis may be generally parallel to the longitudinal axis of the roller. The actuator arm may be positioned relative to the transmission so that the actuator arm does not engage the transmission. When the engagement arm sets the rotation direction of the roller to an extension direction, the shade may extend automatically under the influence of gravity without further action by an operator.

In another example, an operating system for an architectural covering is provided. The operating system may include a base, a drive mechanism operably associated with the base to provide an input torque, a transmission operably

associated with the drive mechanism to selectively transmit the input torque, an engagement arm movably associated with the base and engageable with the transmission, and an actuator arm operably associated with the base and the engagement arm to move the engagement arm relative to the transmission. The actuator arm may be movable about a first axis. The engagement arm may be movable about a second axis that is generally transverse to the first axis. The actuator arm may be positioned relative to the transmission so that the actuator arm does not engage the transmission.

This summary of the disclosure is given to aid understanding, and one of skill in the art will understand that each of the various aspects and features of the disclosure may advantageously be used separately in some instances, or in combination with other aspects and features of the disclosure in other instances. Accordingly, while the disclosure is presented in terms of examples, it should be appreciated that individual aspects of any example can be claimed separately or in combination with aspects and features of that example or any other example.

This summary is neither intended nor should it be construed as being representative of the full extent and scope of the present disclosure. The present disclosure is set forth in various levels of detail in this application and no limitation as to the scope of the claimed subject matter is intended by either the inclusion or non-inclusion of elements, components, or the like in this summary. Moreover, reference made herein to "the present invention" or aspects thereof should be understood to mean certain examples of the present disclosure and should not necessarily be construed as limiting all examples to a particular description.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate examples of the disclosure and, together with the general description given above and the detailed description given below, serve to explain the principles of these examples.

FIGS. **1**A through **1**F are isometric views of a mechanically-operated covering with a shade portion in various positions, while FIG. **1**G is an isometric view of a motorized covering.

FIGS. **2**A and **2**B are section views taken along line **2**A-**2**A as shown in FIG. **1**A and line **2**B-**2**B as shown in FIG. **1**D of one example of a roller with a shade material unwrapped from and wrapped about the roller, respectively.

FIGS. **3**A, **3**B, and **3**C are a distal isometric view, a distal elevation view, and a side elevation view, respectively, of one example of an operating system.

FIGS. **4**A and **4**B are an exploded, distal isometric view and an exploded, proximal isometric view, respectively, of the operating system shown in FIGS. **3**A through **3**C.

FIGS. **5**A, **5**B, and **5**C are a distal elevation view, a section view taken along line **5**B-**5**B as shown in FIG. **5**A, and a section view taken along line **5**C-**5**C as shown in FIG. **5**A, respectively, of the base shown in FIGS. **4**A and **4**B.

FIGS. **6**A and **6**B are an exploded, distal isometric view and an exploded, proximal isometric view, respectively, of the drive mechanism shown in FIGS. **4**A and **4**B.

FIG. **7** is a proximal elevation view of the spool spring shown in FIGS. **6**A and **6**B.

FIGS. **8**A, **8**B, and **8**C are a proximal elevation view, a distal elevation view, and a side elevation view, respectively, of the spool shown in FIGS. **6**A and **6**B.

FIGS. **9**A and **9**B are an exploded, distal isometric view and an exploded, proximal isometric view, respectively, of the transmission shown in FIGS. **4**A and **4**B.

FIG. **10** is a distal elevation view of the clutch element shown in FIGS. **9**A and **9**B.

FIGS. **11**A and **11**B are a side elevation view and a proximal cross-sectional isometric view, respectively, of the axle shown in FIGS. **9**A and **9**B.

FIGS. **12**A and **12**B are a distal isometric view and a distal elevation view, respectively, of one of the wrap springs shown in FIGS. **9**A and **9**B.

FIGS. **13**A and **13**B are a side elevation view and a proximal cross-sectional isometric view, respectively, of the sun gear shown in FIGS. **9**A and **9**B.

FIGS. **14**A and **14**B are a side elevation view and a proximal cross-sectional isometric view, respectively, of the planetary gear carrier shown in FIGS. **9**A and **9**B.

FIGS. **15**A and **15**B are a proximal elevation view and a side elevation view, respectively, of the ring gear shown in FIGS. **9**A and **9**B.

FIGS. **16**A and **16**B are side elevation views of the actuator assembly shown in FIGS. **4**A and **4**B in a retraction mode and an extension mode, respectively.

FIGS. **17**A through **17**F are a distal elevation view, a proximal elevation view, a side elevation view, another side elevation view, yet another side elevation view, and a further side elevation view, respectively, of the lock arm shown in FIGS. **16**A and **16**B.

FIGS. **18**A through **18**E are a distal elevation view, a proximal elevation view, a side elevation view, another side elevation view, and yet another side elevation view of the shift arm shown in FIGS. **16**A and **16**B.

FIG. **19** is an isometric view of the cross pin shown in FIGS. **16**A and **16**B.

FIGS. **20**A and **20**B are a distal isometric view and a distal elevation view, respectively, of one example of an assembly of an end cap, a spool assembly, a clutch element, and an actuator assembly of the operating system shown in FIGS. **4**A and **4**B. FIG. **20**C illustrates the assembly of FIG. **20**B with an electrically controllable actuator mechanism.

FIG. **21**A is a proximal isometric view of the transmission and the actuator assembly shown in FIGS. **4**A and **4**B positioned in a retraction mode.

FIGS. **21**B and **21**C are proximal elevation views of the transmission and the actuator assembly shown in FIG. **21**A with the clutch element in a disengaged and an engaged position, respectively.

FIG. **21**D is a proximal isometric view of the transmission and the actuator assembly of the operating system shown in FIGS. **4**A and **4**B positioned in an extension mode.

FIGS. **22**A and **22**B are a distal isometric view and a distal elevation view, respectively, of an assembled base, drive mechanism, clutch element, axle, brake mechanism, and actuator assembly of the operating system shown in FIGS. **4**A and **4**B.

FIG. **23** is a proximal elevation view of the transmission and the actuator assembly with the axle removed to illustrate the interaction between the wrap springs and the sun gear.

FIGS. **24**A and **24**B are cross-sectional views of the operating system of FIGS. **3**A through **4**B taken along the line **24**A,B-**24**A,B as shown in FIG. **3**B.

FIG. **25** is a section view of another example of an operating system.

FIGS. **26**A and **26**B are distal elevation views of the operating system of FIG. **25** in an extension and a retraction mode, respectively.

It should be understood that the drawings are not necessarily to scale. In certain instances, details that are not necessary for an understanding of the disclosure or that render other details difficult to perceive may have been omitted. In the appended drawings, similar components and/or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label by a letter that distinguishes among the similar components. If only the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label. It should be understood that the claimed subject matter is not necessarily limited to the particular examples or arrangements illustrated herein.

DETAILED DESCRIPTION

The present disclosure provides an operating system for a covering for an architectural opening. The operating system may be a fully contained module mounted on an end of a head rail of the covering and may support an end of an associated roller. The operating system may include a retraction mode and an extension mode. When in the retraction mode, the operating system is operable to raise or retract a shade portion of the covering. When in the extension mode, the operating system is operable to lower or extend the shade portion of the covering.

The operating system may utilize a single operating element, such as a cord or ball chain, to switch the operating system between the retraction and extension modes and, once in the retraction mode, to retract or lift the shade portion of the covering. To switch between modes, an operator may move the operating element in preset directions. In one implementation, a downward motion shifts the operating system into the retraction mode, while a lateral motion shifts the operating system into the extension mode.

Once in the retraction mode, in one implementation a single retractable operating element may be manipulated by an operator with a motion of vertical, reciprocating strokes to retract or lift the shade portion of the covering. A brake element or mechanism may inhibit or prevent the shade portion of the covering from extending or lowering across the architectural opening during retraction. To shift the operating system into the extension mode, an operator may move the operating element in a transverse direction relative to an extension/retraction direction of the shade portion.

Once in the extension mode, the shade portion may extend without further action by the operator. In one implementation, once the operating system is shifted into the extension mode, the shade portion of the covering may lower automatically under the influence of gravity. The operating system may include a speed governing device to control or regulate the extension or lowering speed of the shade portion of the covering.

Referring to FIGS. **1**A through **1**F, a retractable covering **10** for an architectural opening is provided. The retractable covering **10** includes a head rail **14**, a bottom rail **18**, and a shade portion, for example a flexible shade **22**, extending between the head rail **14** and the bottom rail **18**. The head rail **14** includes two opposing end caps **26**A, **26**B, which may enclose the ends of the head rail **14** to provide a finished appearance. The bottom rail **18** may extend horizontally along a lower edge of the shade material **22** and may function as a ballast to maintain the shade **22** in a taut condition and to aid in a gravity-assisted extension of the shade **22**.

The shade **22** may include vertically suspended front **30** and rear **34** sheets of flexible material, such as sheer fabric, and a plurality of horizontally-extending, vertically-spaced flexible vanes **38**. The vanes **38** may be secured along horizontal lines of attachment along front and rear edges to the front and rear sheets **30**, **34**. The sheets **30**, **34** and vanes **38** may form a plurality of elongated, vertically-aligned, laterally-extending, transversely-collapsible cellular units which are longitudinally secured, such as adhered, to adjacent cellular units to define a vertical stack of cellular units, which may be referred to as a cellular panel. The sheets **30**, **34** and/or the vanes **38** may be constructed of continuous lengths of material or may be constructed of strips of material attached or joined together in an edge-to-edge, overlapping, or other suitable relationship.

The shade **22** may be constructed of substantially any type of material. For example, the shade **22** may be constructed from natural and/or synthetic materials, including fabrics, polymers, and/or other suitable materials. Fabric materials may include woven, non-woven, knits, or other suitable fabric types. The shade **22** may have any suitable level of light transmissivity. For example, the shade **22**, including the sheets **30**, **34** and/or the vanes **38**, may be constructed of transparent, translucent, and/or opaque materials to provide a desired ambience or decor in an associated room. In one example, the sheets **30**, **34** are transparent and/or translucent, and the vanes **38** are translucent and/or opaque.

The shade **22** may be operably associated with a roller **42** so that rotational movement of the roller **42** about a longitudinally-extending axis moves the shade **22** between extended and retracted positions. For example, rotation of the roller **42** in a first direction may retract the shade **22** to a position adjacent one or more sides of an associated architectural opening and rotation of the roller **42** in a second, opposite direction may extend the shade **22** across the opening. The shade **22** may be coupled to and wrappable about the roller **42**, as shown in FIGS. **2**A and **2**B, so that rotation of the roller **42** causes the shade **22** to wrap around or unwrap from the roller **42** depending upon the direction of rotation, generally referred to as a roller shade. Alternatively, the shade **22** may be stackable or gatherable adjacent to or beneath the roller **42**. For example, the covering **10** may include lift elements, such as lift cords, wrappable about the roller **42** and extending between the head rail **14** and the bottom rail **18**. As the roller **42** is rotated, the lift elements are wrapped about or unwrapped from the roller **42** to effect extension or retraction of the shade **22**.

Still referring to FIGS. **1**A through **1**F, the covering **10** is shown with the shade **22** in various positions. FIG. **1**A depicts the shade **22** in a fully extended position in which rotation of the roller **42** moves the front and rear sheets **30**, **34** vertically (relative to each other) to shift the vane **38** material between open and closed positions. In the open or expanded position, the front and rear sheets **30**, **34** are horizontally spaced with the vanes **38** extending substantially horizontally therebetween. FIGS. **1**B through **1**F depict the shade **22** in partially extended or retracted positions in which the shade **22** is in the closed position. When in the closed or collapsed position, the front and rear sheets **30**, **34** are relatively close together and the vanes **38** extend generally vertically in an approximately coplanar, contiguous relationship with the front and rear sheets **30**, **34**.

With continued reference to FIGS. **1**A through **1**F, the covering **10** includes an operating system that may allow an operator of the covering **10** to lift or lower the bottom rail **18** between fully retracted and fully extended positions. The operating system may include a drive mechanism configured to provide an input torque to the operating system. The drive mechanism may include a crank, an electrical motor, a spring, an operating element **46** operably coupled to a pulley, or any other suitable drive element or mechanism. The operating element **46** may be a cord, ball chain, or other suitable device. The operating element **46** may have a tassel **50** coupled to a free end of the operating element **46**.

The operating system may be operated mechanically and/or electrically. For illustrative purposes, the example covering **10** shown in FIGS. **1**A through **1**F is operated mechanically with an operating element **46**. As shown in FIG. **1**G, the covering **10** may be operated electrically with a motor **43**, a transceiver **44** operably coupled to the motor **43**, and a transmitter, such as a remote-control unit **45**, operably coupled to the transceiver **44**.

To retract or lift the shade **22** from the fully extended position illustrated in FIG. **1**A, an operator may pull downward on the operating element **46** with approximately vertical, reciprocating or repeating strokes. As shown in FIG. **1**B, upon downward movement of the operating element **46** (represented by the arrow **54**A), the shade material **22** is retracted, raised, or lifted (represented by the arrow **58**A) from the fully extended position of FIG. **1**A. Upon reaching the bottom of the downward stroke of the operating element **46**, an operator may release or resistively raise the operating element **46** and the operating system automatically retracts or reels in the operating element **46** (represented by the arrow **54**B) for repeated actuation.

As shown in FIG. **1**C, as the operating element **46** is retracted, the operating system maintains or holds the shade **22** in its new raised state. Once the operating system has retracted the operating element **46** a distance above the bottom of the stroke, an operator may pull downward on the operating element **46** in a second stroke to further retract the shade **22**, as depicted in FIG. **1**D. This reciprocating process is repeated until the shade **22** is retracted to a desired position. The vertical stroke of the operating element **46** may vary in different implementations of the operating system. In one implementation, the operating element **46** is about 48 inches in length. The ratio of the retraction of the shade **22** to the stroke of the operating element **46** also may vary depending on the specific implementation of the operating system. In one implementation, the ratio of shade **22** retraction to operating element **46** extension is approximately 0.4.

To extend or lower the shade **22** from a fully or partially retracted or lifted position, an operator may pull the operating element **46** in a diagonal or lateral direction across the face of the shade **22**, as indicated by arrow **54**C in FIG. **1**E. The diagonal or lateral movement of the operating element **46** may shift the operating system into an extending mode in which the shade **22** may extend or lower automatically via gravity. Thus, in one implementation, after transitioning the operating system into the extending mode, the operator can release the operating element **46** and walk away from the covering **10** while the shade **22** extends or lowers without operator intervention, as indicated by arrow **58**B in FIG. **1**F. After the shade **22** is extended to a desired position, the operator can inhibit further extension, as well as retract or raise the shade **22**, if desired, by pulling the operating element **46** vertically downward to shift the operating system into the retraction mode. In this retraction mode, the shade **22** may retract in response to the reciprocating process as described above and shown in FIGS. **1**A through **1**D. Additionally, the operating system may include a brake element or mechanism to prevent undesired extension or lowering of the shade **22** when the operating system is in the retraction mode.

With reference to FIGS. **2**A and **2**B, a roller **42** is shown in lengthwise cross section. FIG. **2**A is a section taken along line **2**A-**2**A of FIG. **1**A and illustrates the roller **42** when the shade **22** is in an extended position. FIG. **2**B is a section taken along line **2**B-**2**B of FIG. **1**D and illustrates the roller **42** with a portion of the shade material **22** wrapped about the roller **42**, which may be concealed within the head rail **14**. The roller **42** may be formed in various shapes, including an approximately cylindrical tube as shown in FIGS. **2**A and **2**B.

The roller **42** depicted in FIGS. **2**A and **2**B extends between two opposing end caps **26**A, **26**B and is rotatably coupled to the head rail **14** to retract or extend the shade **22** dependent upon the direction of rotation of the roller **42**. In one implementation, the shade **22** is wrapped about or unwrapped from a rear side of the roller **42**, with the rear side of the roller **42** positioned intermediate the front side of the roller **42** and a street side of an associated architectural opening. To actuate movement of the roller **42**, and thus the shade **22** of the covering **10**, the operating system may be operably associated with an end **66**A, **66**B of the roller **42** and serve as one of the end caps **26**A, **26**B.

Referring to FIGS. **3**A through **3**C, one example of an operating system **70** is provided. The operating system **70** may be assembled as a single, modular unit that couples to one end of the head rail **14** and supports an associated end **66**A of the roller **42**. The operating system **70** may be pre-assembled and thus simplify on-site assembly of the covering **10**. The operating system **70** may be referred to as an operating module or unit.

Referring to FIGS. **4**A and **4**B, the operating system **70** is shown in an exploded, sub-assembly view. The operating system **70** may include a base **74**, a drive mechanism **78**, a transmission **82**, and an actuator or shift mechanism **86**. The base **74**, the drive mechanism **78**, and the transmission **82** may be aligned along a common axis, which may be co-axial with a central axis of the roller **42**. The actuator mechanism **86** may be laterally offset from the common axis and may be coupled to the base **74** near the periphery of the transmission **82**. The actuator mechanism **86** may shift the operating system **70** between retraction and extension modes. In one implementation, the actuator mechanism **86** selectively interacts with the transmission **82** to transition the operating system between modes.

Referring to FIGS. **3**A through **5**C, the operating system **70** may include a base **74** configured to serve as an end cap **26**A of the head rail **14** and to provide a foundation for the remaining components of the operating system **70**. The base **74** may have a proximal face **90** and a distal face **94**. The proximal face **90** may be exposed when attached to the head rail **14**, and the distal face **94** may confront the drive mechanism **78**, the transmission **82**, and the actuator mechanism **86**.

To attach the base **74** to the head rail **14**, the base **74** may include a distally-extending, peripheral flange **98**. The flange **98** may define a female receptacle **102** (see FIG. **5**A) configured to snugly receive a corresponding male feature of the head rail **14**. When looking at the distal face **94** of the base **74** (see FIG. **5**A), the flange **98** may be inset from the right or front edge **106** of the base **74** to provide lateral space for the end of the head rail **14** to occupy in abutting relationship to an outer, front surface **110** of the flange **98**. The inset distance may be designed to form a flush or seamless transition between the edge **106** of the base **74** and an outer, front surface of the head rail **14**.

To attach the base **74** to the drive mechanism **78** and the transmission **82**, the base **74** may include a post **114** extending distally from the distal face **94** of the base **74**, as shown in FIGS. **4**A, **5**A, and **5**B. The post **114** may include a proximal, smooth portion **118** and a distal, splined portion **122**. That is, the smooth portion **118** may be located intermediate the distal face **94** and the splined portion **122**. The splined portion **122** may have a smaller outer diameter than the smooth portion **118**, thus defining a transitionary shoulder **126** located between the smooth and splined portions **118**, **122** of the post **114**. The post **114** may be hollow and may have an internal wall **130** that defines an axially-extending bore **134**. The portion of the wall **130** corresponding to the splined portion **122** may be threaded.

With continued reference to FIGS. **4**A, **5**A, and **5**B, the base **74** also may include a spool spring anchor **138** extending distally from the distal face **94** of the base **74** and positioned radially outward from the post **114**. The anchor **138** may form a substantially circular arc, although other configurations are contemplated. If arc-shaped, the anchor **138** may extend any suitable angle around the central axis of the post **114**. For example, the arc-shaped anchor **138** depicted in FIG. **5**A extends about 45 degrees around a central axis of the post **114**, although other angles more or less than 45 degrees are contemplated.

As shown in FIGS. **4**A, **5**A, and **5**B, the base **74** further may include an inner annular rim **142** and an outer annular rim **146**, both of which may extend distally from the distal face **94** of the base **74**. The inner annular rim **142** is located radially outward of the post **114** and the anchor **138**. The inner annular rim **142** may form a substantially continuous ring around the post **114** to define a space **148** located radially between the inner annular rim **142** and the post **114**. The space **148** may be configured to receive the drive mechanism **78**. When the drive mechanism **78** is seated within the space **148**, a distal face of the drive mechanism **78** may be substantially flush or congruent with a distal face **150** of the inner annular rim **142**.

Still referring to FIGS. **4**A, **5**A, and **5**B, the outer annular rim **146** is spaced radially outward from the inner annular rim **142** and extends distally beyond a distal face **150** of the inner annular rim **142**. That is, a distal face **154** of the outer annular rim **146** is located distally of the distal face **150** of the inner annular rim **142**. Thus, the outer annular rim **146** defines an interior space located distally of and contiguous with the space defined by the inner annular rim **142**. A portion of the outer annular rim **146** interior space extends radially outward of the inner annular rim **142** and receives a proximal portion of the transmission **82**. The base **74** may include radially-extending spokes **158** that extend between the inner and outer annular rims **142**, **146**. The spokes **158** may be distally congruent with the distal face **150** of the inner annular rim **142**.

With reference to FIGS. **4**A and **5**A, the base **74** further may define an operating element conduit **162** that extends through the inner and outer annular rims **142**, **146**. The conduit **162** may be configured to accommodate the passage of an operating element **46**, such as a cord or ball chain. As such, the operating element **46** can be threaded through the conduit **162** so that a portion of the operating element **46** is positioned within the inner rim **142** and a portion of the operating element **46** is positioned outside of the outer rim **146**, where the operating element **46** is accessible by an operator (see FIGS. **1**A through **1**F, for example).

Referring to FIGS. **4**A, **5**A, and **5**B, the outer annular rim **146** may form a discontinuous ring around the inner annular rim **142** so that a portion of the inner annular rim **142** is not surrounded by the outer annular rim **146**. A lock component of the actuator mechanism **86** may be operably coupled to the base **74** radially outward of, and adjacent to, the unsurrounded portion of the inner annular rim **142**, which also may be described as the missing section or gap in the outer rim **146**. In one implementation, the lock component of the actuator mechanism **86** is selectively positioned near the inner annular rim **142** to shift the operating system **70** into the retraction mode and away from the inner annular rim **142** to shift the operating system **70** into the extension mode.

Referring to FIG. **5**A, adjacent to an upper end of the unsurrounded portion of the inner annular rim **142**, the base **74** may include a boss **166** that extends distally from the distal face **94** of the base **74**. The boss **166** may define a substantially cylindrical pivot aperture **170** configured to pivotably seat the lock component of the actuator mechanism **86**. The boss **166** may include a recessed portion **174** to delimit a pivotable range of the lock component of the actuator mechanism **86**. Adjacent to the boss **166** and radially outward from the missing section or gap of the outer rim **146**, the base **74** may include placement tabs **178** that protrude from an inner wall of the flange **98** to define a seat for a biasing element, such as a spring.

With reference to FIGS. **4**A and **5**A, adjacent to the operating element conduit **162**, the outer annular rim **146** may be positioned radially inward of the flange **98** in an overlapping relationship. The outer annular rim **146** and the flange **98** may each include an opposing guide rail **182**A, **182**B that extend toward each other to define a gap therebetween. A shifting component of the actuator mechanism **86** may be positioned between the opposing guide rails **182**A, **182**B.

Below the guide rails **182**A, **182**B, the base **74** may include a pair of spaced protuberances **186**A, **186**B that extend laterally between the outer annular rim **146** and the flange **98**. The protuberances **186**A, **186**B may protrude distally from the distal face **94** of the base **74**, and each of the protuberances may include an arcuate or curved surface that oppose each other to define a seat for a cross pin **190** (see FIG. **19**). Near the terminal ends of the protuberances **186**A, **186**B, the flange **98** and the outer annular rim **146** each may include a recession or opening, such as the aperture **192** formed in the flange **98**, to house the ends of the cross pin **190**.

Referring now to FIGS. **4**A, **4**B, and **6**A through **8**C, an example drive mechanism **78** of the operating system **70** is provided. The depicted drive mechanism **78** comprises a spool assembly having a spool **194** biased by a power or spool spring **198**. Although as previously discussed, the operating system may be motorized.

The spool **194**, as shown in FIG. **8**C, may include a proximal face **210**, a distal face **214**, and a circumferential groove **218** formed between the proximal and distal faces **210**, **214**. As shown in FIGS. **4**A, **4**B, **6**A, **6**B, **8**A, and **8**B, the spool **194** also may include a central aperture **226**, defined by a substantially cylindrical wall **222**, that is sized to receive the smooth portion **118** of the post **114** of the base **74**. During operation, the wall **222** of the spool **194** may rotatably bear against the smooth portion **118** of the post **114**.

With reference to FIGS. **6**B and **8**A, the proximal face **210** of the spool **194** has a proximal abutment surface **230** positioned proximal and radially outward from an interior cavity **234**. A spool spring anchor **238** may be located within the cavity **234**. The anchor **238** may form a substantially circular arc, although other configurations are contemplated. The arc-shaped anchor **238** may extend any suitable angle around the central axis of the aperture **226**. For example, the arc-shaped anchor **238** depicted in FIG. **5**A extends about 60 degrees around a central axis of the aperture **226**, although other angles more or less than 60 degrees are contemplated. When the operating system **70** is assembled, the proximal abutment surface **230** of the spool **194** may bear against the distal face **94** of the base **74**, the outer periphery of the spool **194** may be disposed radially inward of the inner annular rim **142**, and the distal face **214** of the spool **194** may be approximately flush with the distal face **150** of the inner annular rim **142**.

The spool spring **198**, as shown in FIGS. **6**A through **7**, is configured to provide a spool **194** retraction force and may be housed within the inner cavity **234** of the spool **194**. The spool spring **198** may include a number of windings extending between an inner end portion **202** and an outer end portion **206**. The inner and outer end portions **202**, **206** each may be folded over to form an inner and outer hook, respectively, so that when the operating system **70** is assembled, the inner end portion **202** engages the anchor **138** of the base **74** and the outer end portion **206** engages the anchor **238** of the spool **194**. In this configuration, when viewing the distal face **94** of the base **74**, a clockwise rotation of the spool **194** relative to the base **74** radially contracts the windings of the spool spring **198** to create a counterclockwise biasing force, resulting in a spool retraction force.

Referring to FIGS. **6**A, **8**B, and **8**C, the distal face **214** of the spool **194** may include an embossed ring **240** encircling the central aperture **226** and a pair of diametrically opposed clutch tabs **242** located along a radially outward portion of the ring **240**. Each of the clutch tabs **242** may be formed in an apostrophe or comma shape with a radially thicker clockwise trailing edge **246** and a radially thinner clockwise leading edge **250**. Each of the tabs **242** also may include a curved inner surface or wall **254** that extends between the trailing and leading edges **246**, **250**. Additionally, each of the tabs **242** may include a ramp or cam surface **256** that inclines outward from the leading edge **250** toward the trailing edge **246**. In other words, the cam surface **256** may incline in a counterclockwise direction from the leading edge **250** of each of the tabs **242**. Near the trailing edge **246** of each of the tabs **242**, the ramp or cam surface **256** may terminate at a stop shoulder **258**.

Referring to FIG. **8**C, the spool **194** includes a circumferential groove **218** formed between the proximal and distal faces **210**, **214**. Although not depicted in FIG. **8**C, the operating element **46** may be wound around the spool **194** and disposed within the groove **218**, which may be formed to receive various lengths of the operating element **46**. For example, in one implementation, about 48 inches of the operating element **48** may be wound around and located within the groove **218**. To couple the operating element **48** to the spool **194**, one end of the operating element **48** may be routed through a slot **262**A or **262**B (see FIG. **8**A) formed in a proximal side wall **266**A of the groove **218**, placed within the inner cavity **234** of the spool **194**, and knotted, secured, or otherwise configured to prevent that end of the operating element **46** from being displaced from the cavity **234**. After being wound around the groove **218**, the other end of the operating element **46** may be routed through a slot **270** formed in a distal side wall **266**B of the groove **218** (see FIG. **8**C) and temporarily secured distally of the distal side wall **266**B until the spool assembly is operably coupled to the base **74**.

Referring now to FIGS. **9**A and **9**B, an example transmission **82** of the operating system **70** is shown in exploded below. The transmission **82** includes a clutch element **274**, an axle **278**, at least one wrap spring **282**, a sun gear **286**, a plurality of planet gears **290**, an annulus or ring gear **294**, a planet carrier **298**, and a fastener **302**. When assembled, the components of the transmission **82** may be coaxially aligned with the post **114** of the base **74**. During shade **22** retraction, the transmission **82** generally receives an input torque from the drive mechanism **78** and provides an output torque to the roller **42**. The transmission **82** may provide a gear reduction, such as by the example planetary gear system, to reduce the amount of input torque required to retract the shade **22**. During shade **22** extension, the transmission **82** may be disengaged from the other components of the operating system **70** so that the roller **42** can rotate in an extension or lowering direction via gravity.

Referring to FIGS. **9**A through **10**, the clutch element **274** may serve as a one-way clutch transferring torque from the spool **194** to the sun gear **286** during extension of the operating element **46**, while allowing free rotation of the spool **194** relative to the sun gear **286** during retraction of the operating element **46**. With reference to FIG. **10**, the clutch element **274** may include a body **306** with two resilient arms **310**A, **310**B each having a connected end **314** and a free end **318**. The body **306** also may include an inner bearing surface **330** and opposing outer bearing surfaces **334**A, **334**B that each extend between proximal and distal faces **322**, **326** of the clutch element **274**. The outer bearing surfaces **334**A, **334**B each may terminate at shoulders, namely a clockwise rotation shoulder **338** and a counterclockwise rotation shoulder **342**.

The resilient arms **310**A, **310**B each wrap about the bearing surfaces **334**A, B in a radially spaced relationship and in a counterclockwise direction. Each of the resilient arms **310**, in combination with a corresponding bearing surface **334**, define a gap **346** closed at one end by the clockwise rotation shoulder **338** and open at the other, entrance end. The free end **318** of each of the arms **310** include an outward directed barb **350**. When the operating system **70** is assembled, the inner surface **330** of the body **306** rotatably bears against the smooth portion **118** of the post **114** of the base **74** and the proximal face **322** of the body **306** abuts against the ring **240** of the spool **194**.

As shown in FIGS. **20**A and **20**B, the clutch element **274** may be axially positioned on the smooth portion **118** of the post **114** of the base **74**. Upon extension of the operating element **46** (see FIGS. **1**A and **1**D), the spool **194** rotates in a shade retraction direction (as indicated by arrow A in FIG. **20**B) about the post **114**. The rotation of the spool **194** moves the clockwise leading edge **250** of each of the clutch tabs **242** radially between the resilient arms **310** and the body **306** of the clutch element and towards the clockwise rotation shoulder **338** located at the intersection of the arms **310** and the body **306**. As the leading edges **250** of the clutch tabs **242** move toward the shoulder **338**, the resilient arms **310** ride up the cam surfaces **256** of the clutch tabs **242** and are expanded radially outward, thereby increasing the effective outer diameter of the clutch element **274**. Once the stop shoulders **258** of the clutch tabs **242** contact the free ends **318** of the resilient arms **310**, the clutch tabs **242** drive the arms **310**, and hence the clutch element **274**, in a clockwise direction.

During retraction of the operating element **46** (see FIG. **1**C), the spool **194** rotates in a shade extension direction (as indicated by arrow B in FIG. **20**B) about the post **114**. The shade extension rotation of the spool **194** moves the clockwise trailing edge **246** of each of the clutch tabs **242** towards the counterclockwise rotation shoulder **342**. As the trailing edges **246** of the clutch tabs **242** move toward the shoulder **342**, the resilient arms **310** descend down the cam surfaces **256** of the clutch tabs **242** and contract radially inward to a non-deformed state, thereby decreasing the effective outer diameter of the clutch element **274**. Once the trailing edges **246** of the clutch tabs **242** contact the shoulder **342**, the clutch tabs **242** drive the clutch element **274** in the shade extension direction. However, as will be discussed below, the decreased effective outer diameter of the clutch element **274** isolates the rotation of the spool **194** from the transmission **82**, thereby enabling retraction of the operating element **46** without impacting the position of the shade **22**.

Referring to FIGS. **9**A, **9**B, **11**A, and **11**B, one example of an axle **278** of the operating system **70** is provided. When the operating system **70** is assembled, the axle **278** is keyed to the base **74** to prevent rotation of the axle **278** relative to the base **74**. That is, the axle **278** is non-rotatably coupled to the base **74**. Referring to FIGS. **11**A and **11**B, the example axle **278** includes an interior wall **352** and an exterior wall **354**. The interior wall **352** may define a bore **358** extending longitudinally through the axle **278**. The proximal portion of the interior wall **352** may include a cylindrical section **362**, a splined section **366**, and a transition section **370** located intermediate the cylindrical section **362** and the splined section **366**. The cylindrical section **362** may have a larger diameter than the splined section **366**, which includes alternating ribs and grooves. The transition section **370** may be arcuate, curved, or chamfered. The distal portion of the interior wall **352** may be substantially smooth and cylindrical. When the operating system **70** is assembled, the cylindrical section **362** may abut the smooth portion **118** of the post **114** of the base **74**, the splined section **366** may matingly engage the splined portion **122** of the post **114**, and the proximal face of the stepped shoulder of the splined section **366** may abut the distal face of the post **114**.

The exterior wall **354** of the axle **278** may include a radially-extending flange **374**, a tapered distal surface **378**, and a cylindrical surface **382** located intermediate the flange **374** and the tapered surface **378**. A step shoulder **386** may be formed between the larger diameter cylindrical surface **382** and the smaller diameter tapered surface **378**. The axle **278** also may include a proximal face **390** and a distal face **394**. When the operating system **70** is assembled, the proximal face **390** may abut the distal face **326** of the clutch element **274** and the distal face **394** may bear against the underside of the head of the threaded fastener **302**.

Referring to FIGS. **9**A, **9**B, **12**A, and **12**B, a brake element or mechanism is provided. The example brake element includes two identical wrap springs **282**. When the operating system **70** is assembled, the wrap springs **282** are interference fit onto the cylindrical section **362** of the axle **278**, as shown in FIGS. **22**A and **22**B. As such, the wrap springs **282** function as a one-way brake and are configured to rotationally slip around the axle **278** in a shade retraction direction (as indicated by arrow A in FIG. **22**B) and clamp or lock onto the axle **278** in a shade extension direction (as indicated by arrow B in FIG. **22**B). Thus, in one implementation, as the operating element **46** is extended from the spool **194**, the spool **194** rotates and the wrap springs **282** rotationally slip about the axle **282** to raise or retract the shade **22**. However, as the operating element **46** is reeled in by the spool **194**, the wrap springs **282** lock about the axle **278** to prevent unintentional extension or lowering of the shade **22**.

With reference to FIGS. **12**A and **12**B, each wrap spring **282** includes terminal end segments **398**, **402** spatially separated by a number of windings. One end segment **398** may be directed slightly outward to prevent inadvertent catching, gouging, or scarring of the cylindrical section **362** of the axle **278**. The other end segment **402** may extend radially outward to form a tang. Although two wrap springs **282** are provided for illustrative purposes, other configurations are contemplated. For instance, any number of wrap springs **282**, such as one, two, or more than two, may be utilized. In addition, if a plurality of wrap springs **282** are used, the wrap springs **282** may be different from each other.

Referring to FIGS. **9**A, **9**B, **13**A, and **13**B, an example sun gear **286** of the transmission **82** is provided. The sun gear **286** may include external gear teeth **404** and a hollow interior. The sun gear **286** also may include an inner surface defining a proximal clutch portion **406** and a distal brake portion **410**. The clutch portion **406** may include circumferentially spaced, radially-inward directed ridges **414** that define recesses **418** between the ridges **414**. The clutch portion **406** may receive the clutch element **274**, as shown in FIGS. **21**A through **21**D.

When the resilient arms **310** of the clutch element **274** are in a non-deformed state, as shown in FIG. **21**B, the effective outer diameter of the clutch element **274** is smaller than the inner diameter of the ridges **414** of the sun gear **286**. As previously discussed, the clutch element **274** may be in a non-deformed state, and thus may rotate within the sun gear **286** without interference, when the spool **194** rotates in a shade extension direction. As such, during retraction of the operating element **46**, the clutch element **274** may rotatably isolate the sun gear **286** from the spool **194** or any other suitable drive mechanism.

When the resilient arms **310** of the clutch element **274** are in a deformed state, as shown in FIG. **21**C, the barbs **350** of the radially-expanded, resilient arms **310** are located within opposing recesses **418** and engage opposing ridges **414** to transfer rotation of the spool **194** to the sun gear **286**. As previously discussed, the clutch element **274** may be in a radially-expanded state, and thus rotatably couple the sun gear **286** to the spool **194**, when the spool **194** rotates in a shade retraction direction. As such, during extension of the operating element **46**, the clutch element **274** may rotatably couple the sun gear **286** to the spool **194** (as shown in FIG. **21**C) or any other suitable drive mechanism.

With reference to FIG. **13**B, the brake portion **410** of the sun gear **286** may extend distally from the clutch portion **406**. The brake portion **410** may include a counterbore section **422**, a radially inturned lip **426**, and at least one slot **430** extending longitudinally between the proximal counterbore section **422** and the distal lip **426**. The counterbore section **422** may be configured to seat the flange **374** of the axle **278**. When assembled, the proximal face **390** of the axle **278** may be approximately flush or congruent with the leading proximal edge of the brake portion **410** (as shown in FIG. **25**B). Also when assembled, the radially inturned lip **426** may rotatably bear against a distal portion of the cylindrical surface **382** of the axle **278** and may be distally aligned with the step shoulder **386** of the axle **278** (see FIG. **25**B). The radially inturned lip **426** also may axially retain the wrap spring **282** around the cylindrical surface **382** of the axle **278**.

The at least one slot **430** of the brake portion **410** of the sun gear **286** may be configured to receive the tangs **402** of the wrap springs **282** to rotatably lock the wrap springs **282** and the sun gear **286** depending on the direction of rotation. As shown in FIG. **23** (axle **278** is removed for clarity), two wrap springs **282** are positioned coaxially within the sun gear **286**. The tang **402** of each wrap spring **282** extends into one of the four circumferentially spaced slots **430** so that the rotation of the sun gear is rotatably linked to each wrap spring **282**.

With continued reference to FIG. **23**, upon extension of the operating element **46** (see FIGS. **1**B and **1**D), the spool **194** rotates in a shade retraction direction (as indicated by arrow A in FIG. **23**), the clutch tabs **242** radially expand the resilient arms **310**, and the barbs **350** engage the ridges **414** of the clutch portion **406** of the sun gear **286** to transmit the spool **194** torque to the sun gear **286**. Upon rotation of the sun gear **286** in the shade retraction direction, a wall of the slot **430** contacts the tang **402** of the wrap springs **282** and radially expands the windings of the at least one wrap spring **282**. The radial expansion of the windings permits the wrap springs **282** to rotationally slip around the stationary axle **278** in the shade retraction direction.

Upon retraction of the operating element **46** (see FIG. **1**C), the spool **194** rotates in a shade extension direction (as indicated by arrow B in FIG. **23**), the clutch tabs **242** contact the counterclockwise rotation shoulders **342**, and the clutch element **274** rotates freely within the clutch portion **406** of the sun gear **286** without transmitting the spool **194** torque to the sun gear **286**. Thus, torque from the spool **194** is not transmitted to the sun gear **286** in the shade extension direction.

In addition to the clutch element **274** not transmitting torque in the shade extension direction from the spool **194** to the sun gear **286**, the wrap springs **282** may prevent the sun gear **286** from rotating in the shade extension direction due to the weight of the shade **22** imparting a shade extension torque on the roller **42**. Upon rotation of the sun gear **286** in the shade extension direction, a wall of the slot **430** contacts the tang **402** of the wrap springs **282** and radially contracts the windings about the cylindrical surface **382** of the axle **278**. The radial contraction of the windings prevents rotation of the sun gear **286** about the stationary axle **278** in the shade extension direction. In this manner, the wrap springs **282** act as a brake mechanism to lock or maintain the desired position of the shade **22** relative to the architectural opening.

Referring to FIGS. **9**A, **9**B, **14**A, and **14**B, an example planetary gear carrier **298** of the transmission **82** is provided. The planetary gear carrier **298** may include a carrier portion **434** and a bearing portion **438**. The carrier portion **434** may include a radially extending flange **442** with a proximal face **446**. The carrier portion **434** also may include a plurality of pins **450** that extend proximally from the face **446**. Each of the pins **450** may support a planet gear **290** (shown in FIGS. **9**A and **9**B). The carrier portion **434** may include any suitable number of pins **450**. In one implementation, the carrier portion **434** includes at least three pins **450**. In the depicted implementation, the carrier portion **434** includes six pins **450**.

The bearing portion **438** of the gear carrier **298** may be configured to fit into an end of the roller **42** and transmit motion between the gear carrier **298** and the roller **42**. The bearing portion **438** may include a plurality of ribs **454** extending distally from the flange **442** and radially outward from a tiered wall **458**. The ribs **454** may be configured to rotatably couple the gear carrier **298** and roller **42**. For example, the ribs **454** may frictionally engage an inner portion of the roller **42**, may key into corresponding interior features of the roller, or otherwise couple the components together. The bearing portion **438** may include any suitable number of ribs **454**. In one implementation, the plug portion **438** includes at least three ribs **454**. In the depicted implementation, the plug portion **438** includes six ribs **454** (see FIG. **9**A).

The tiered wall **458** of the gear carrier **298** may define a larger diameter proximal cavity **462** and a smaller diameter distal cavity **466**. The proximal cavity **462** may be configured to house the sun gear **286** (except for the external gear teeth **404**). The distal cavity **466** may be configured to house, and may radially abut, the tapered surface **378** of the axle **278**. Although depicted as an integral unit, the carrier portion **434** and the bearing portion **438** of the gear carrier **298** may be individual components that are coupled together.

Referring to FIGS. **9**A, **9**B, **15**A, and **15**B, an example annulus or ring gear **294** of the transmission **82** is provided. The ring gear **294** may include inwardly directed gear teeth **470**, outwardly directed teeth **474** located radially outward from the gear teeth **470**, and a series of bridges **478** extending radially between the inwardly directed gear teeth **470** and the outwardly directed teeth **474**. The bridges **478** may be spaced apart from one another to reduce the amount of material, and thus the weight, of the ring gear **294**. In some implementations the ring gear **294** may be constructed of plastic, in which case the spaces between the bridges **478** may reduce warpage, sinks, and/or voids. The ring gear **294** may include a circumferential flange or cap **482** extending radially outward and distally from the outward directed teeth **474**.

With reference to FIGS. **21**A through **21**D and FIG. **23**, when the operating system **70** is assembled, the planet gears **290** mesh between the sun gear **286** and the ring gear **294**. The sun gear **286**, planet gears **290**, ring gear **294**, and planet carrier **298** generally form a planetary gear set or gear reduction unit, thereby reducing the amount of force required to retract or raise the shade **22**. In one implementation, the gear ratio of the planetary gear set is 2.5.

As previously discussed, during extension of the operating element **46** (see FIGS. **1**B and **1**D), the sun gear **286** rotates relative to the stationary axle **278** in a shade retraction direction. If the ring gear **294** is rotatably locked during this rotation of the sun gear **286**, the planet gears **290** rotate about their respective pins **450** and orbit around the sun gear **286**. The orbiting motion of the planet gears **290** rotate the planet carrier **298**, which in turn rotates the roller **42** in a shade retraction direction.

During retraction of the operating element **46** (see FIG. **1**C), the sun gear **286** is rotatably isolated from the spool **294** and thus does not rotate the planet carrier **298**. In addition, during retraction of the operating element **46**, the weight of the shade **22** suspended from one edge of the roller **42** may impart a torque on the roller in the shade extension direction. This torque may be transferred to the planet gears **290** through the planet carrier **298**. As previously discussed, the wrap springs **282** may prevent rotation of the sun gear **286** in the shade extension direction. Thus, if the sun gear **286** and the ring gear **294** are rotatably locked, the planet gears **290** are prevented from moving, which in turn maintains the shade **22** in the current position. Alternatively, if the ring gear **294** is not rotatably locked, the planet gears **290** may orbit about the sun gear **286** in the shade extension direction to extend the shade **22** across the architectural opening.

Referring now to FIGS. **4**A, **4**B, and **16**A through **19**, an example actuator or shift mechanism **86** of the operating system **70** is provided. The actuator mechanism **86** selectively engages the transmission **82** to transition the operating system **70** between retraction and extension modes. Although the following discussion describes an actuator mechanism **86** shifted mechanically by an operating element **46**, the actuator mechanism **86** may be mechanically and/or electrically actuated. For instance, as shown in FIG. **20**C, an electrically-controlled actuator **484** may be attached to the base **74** and positioned to selectively shift the actuator mechanism **86** between retraction and extension modes. The actuator **484** may interact with the actuator mechanism **86** in various manners, such as electromagnetically, to move the actuator mechanism **86**. The actuator **484** may be electrically coupled with a transceiver operable to receive signals from a remote transmitter, such as a remote-control unit **45** (see FIG. **1**G), and transmit signals to a remote receiver. Electrically-controlled linear and/or rotary actuators may be used.

In one implementation, an operator shifts the actuator mechanism **86** between modes by manipulating an operating element **46** in a predefined direction. For instance, the operator may pull the operating element **46** across the face of the shade **22** in a diagonal or lateral movement (e.g., arrow **54**C in FIG. **1**E) to shift the actuator mechanism **86** into a shade extension mode, thereby permitting the shade **22** to automatically extend or lower, such as via gravity. Once in the shade extension mode, the operator may shift the actuator mechanism **86** into a shade retraction mode (which stops the extension) by pulling the operating element **46** vertically downward or in a direction opposite to that shown in FIG. **1**E.

Referring to FIGS. **16**A, **16**B, **21**A, and **21**D, the actuator mechanism **86** may include an engagement or lock arm **490** and an actuator or shift arm **486**. The lock arm **490** may be pivotably associated with the base **74** of the operating system **70**. In one implementation, the lock arm **490** has a preset pivotable range. At one end of the pivotal range, the lock arm **490** engages the transmission **82** to substantially prevent rotation of the roller **42** in a shade extending direction, which may be referred to as the shade retraction mode. At the other end of the pivotal range, the lock arm **490** disengages from the transmission **82** to permit rotation of the roller in the shade extending direction, which may be referred to as the shade extension mode. The lock arm **490** may be biased toward the shade retraction mode by a biasing element such as a spring.

An example lock arm **490** is provided in FIGS. **17**A through **17**F. The lock arm **490** may include a post **494** configured to be rotatably seated within the pivot aperture **170** of the base **74**, a cutout **498** configured to receive a portion of the boss **166**, and an overpass **502** located distally of the cutout **498** and configured to be seated within the recessed portion **174** of the boss **166** to limit the pivotal range of the lock arm **490**. The post **494**, the boss **166**, or both may include catch or snap features to axially interlock the post **494** within the pivot aperture **170** while permitting rotation of the lock arm **490** relative to the base **74**. A biasing element, such as a torsion spring, may be associated with the post **494** and the boss **166** to rotationally bias the lock arm **490** toward the shade retraction mode, for example. The pivot axis of the lock arm **490** may be generally parallel to a central longitudinal axis of the transmission **82**. When assembled, the post **494** may extend in a proximal direction towards the base **74** and away from the roller **42**.

The lock arm **490** also may include an engagement tooth **518** configured to engage the transmission **82** when the actuator mechanism **86** is in the shade retraction mode. When the actuator mechanism **86** is in the shade retraction mode, as shown in FIGS. **21**A through **21**C, the engagement tooth **518** of the lock arm **490** may matingly engage or intermesh with the outwardly directed teeth **474** of the ring gear **294** to substantially prevent rotation of the ring gear **294**. When the actuator mechanism **86** is in the shade extension mode, the lock arm **490** may be pivoted away from the transmission **82** so that the engagement tooth **518** is spatially separated from the outwardly directed teeth **474** of the ring gear **294** to permit rotation of the ring gear **294**. The tooth **518** may include a buttress or rib **520** extending proximally from the tooth **518** to provide additional rigidity to the tooth **518**. The distal surface **526** of the lock arm **490**, including the engagement tooth **518**, may be approximately planar and configured to abut the proximal face of the circumferential flange or cap **482** of the ring gear **294**.

As previously discussed, the actuator mechanism **86** may be biased toward the shade retraction mode. In the implementation depicted in FIGS. **17**A through **17**F, the lock arm **490** includes a mandrel **522** configured to seat one end of a compression spring **524** (shown in FIGS. **20**B and **22**B), with the other end of the compression spring **524** seated within the placement tabs **178** protruding from the flange **98** of the base **74** (see FIG. **5**A). In this implementation, the compression spring **524** pivots the lock arm **490** into the shade retraction mode in which the engagement tooth **518** is engaged with an outwardly directed tooth **474** of the ring gear **294** to prevent rotation of the ring gear **294**. The mandrel **522** may be conical, cylindrical, or any other suitable shape.

With continued reference to FIGS. **17**A through **17**F, the lock arm **490** additionally may include a biasing or contact surface **506**, a retention surface **510**, and a detent **514** located intermediate the contact surface **506** and the retention surface **510**. The contact surface **506** may extend in a distal direction from the detent **514** at an oblique angle relative to a longitudinal plane. The retention surface **510** may extend in a proximal direction from the detent **514** in a parallel relationship to a longitudinal plane. In other words, the biasing or contact surface **506** may be oriented at an oblique angle relative to the retention surface **510**. The detent **514** may protrude outward from the lock arm **490** relative to the contact surface **506** and the retention surface **510**, both of which may be substantially planar. The contact surface **506**, the retention surface **510**, and/or the detent **514** may be formed of a wear resistant material, which may be uniform with the lock arm **490**. In one implementation, the contact surface **506**, the retention surface **510**, and/or the detent **514** may be plated, treated, or otherwise associated with nickel or any other suitable material to provide wear resistance.

To transition the actuator mechanism **86** between modes, the actuator mechanism **86** may include a shift arm **486** configured to manipulate the position of the lock arm **490** relative to the transmission **82**. The shift arm **486** may be rotatably coupled to the base **74** of the operating system **70** and may have a preset rotatable range. At one end of the rotatable range, the shift arm **486** disengages the lock arm **490** from the transmission **82** to permit rotation of the roller **42** in a shade extending direction, generally referred to as the shade extension mode (see FIGS. **16**B and **21**D). At the other end of the rotatable range, the shift arm **486** does not interfere with the engagement of the lock arm **490** and the transmission **82**, generally referred to as the shade retraction mode (see FIGS. **16**A and **21**A through **21**C). When the operating system **70** is in the shade extension mode, the shift arm **486** may retain the lock arm **490** in a disengaged position relative to the transmission **82** until an external force pivots or rotates the shift arm **486** about the cross pin **190**, moving a lower portion of the shift arm **486** toward the base **74** and an upper portion of the shift arm **486** away from the base **74**, thereby shifting the operating system **70** into the shade retraction mode. The rotation axis of the shift arm **486** may be approximately perpendicular to the pivot axis of the lock arm **490**.

An example shift arm **486** is provided in FIGS. **18**A through **18**E. The shift arm **486** may include a pin housing

530 configured to receive a cross pin 190 (shown in FIG. 19). As such, the cross pin 190, the pin housing 530, or both may serve as a pivot point or fulcrum for the shift arm 486. With reference to FIGS. 5A and 5C, the pin housing 530 may be rotatably seated between the protuberances 186A, 186B and the ends of the cross pin 190 may be rotatably seated in opposing recesses or openings in the rim 146 and the flange 98, such as the aperture 192 formed in the flange 98.

At one end of the rotatable range of the shift arm 486, the shift arm 486 engages the lock arm 490, causing the lock arm 490 to disengage the outward facing teeth 474 of the ring gear 294, generally referred to as the shade extension mode. In this mode (see FIGS. 16B and 21D), the lock arm 490 permits rotation of the ring gear 294, thereby permitting extension of the shade 22, which may be under the effect of gravity. At the other end of the rotatable range of the shift arm 486, the shift arm 486 does not displace the lock arm 490, allowing the lock arm 490 to engage the ring gear 294 under spring load, generally referred to as the shade retraction mode. In this mode (see FIGS. 16A and 21A through 21C), the lock arm 490 prevents rotation of the ring gear 294, thereby preventing extension of the shade 22 and enabling retraction of the shade 22.

Referring back to FIGS. 18A through 18E, the shift arm 486 also may include first and second lever portions or arms 534, 538 extending away from the pin housing 530 in different directions, which may be opposing. The first lever arm 534 may include an eyelet 542 configured to accommodate the passage of the operating element 46. The eyelet 542 may be closed, as shown in FIG. 18D, or open. As shown in FIGS. 20A and 20B, when the shift arm 486 is coupled to the base 74, the eyelet 542 may be approximately vertically aligned with the operating element conduit 162 extending through inner and outer annular rims 142, 146 of the base 74 so that a vertical movement of the operating element 46 (see FIGS. 1B through 1D) may not pivot or rotate the shift arm 486 about the cross pin 190 but a lateral movement of the operating element 46 transverse to the rotation axis of the shift arm 486 (see FIG. 1E) may pivot or rotate the shift arm 486 about the cross pin 190. As shown in FIG. 18C, the first lever arm 534 also may include a guide or pathway 546 to facilitate threading of the operating element 46 through the eyelet 542. The eyelet 542 may open through an angled bottom surface 548 of the shift arm 486.

With continued reference to FIGS. 18A through 18E, the second lever arm 538 may include a biasing face or surface 550 located on a proximal side of the arm 538 and a retaining shoulder 554 located on a distal side of the arm 538, both of which may be associated with a terminal end 558 of the second lever arm 538. The biasing face 550 may be rounded to facilitate smooth engagement with, and thus shifting of, the lock arm 490. With reference to FIGS. 16A and 16B, upon rotation of the shift arm 486 in a first direction, as indicated by arrow 562, the biasing face 550 contacts the biasing surface 506 of the lock arm 490 to pivot the lock arm 490 about the post 494, thereby disengaging the engagement tooth 518 from the outer teeth 474 of the ring gear 294 to permit extension of the shade 22. Once the biasing face 550 surpasses the detent 514, the retaining shoulder 554 engages the detent 514 and retains the lock arm 490 in the shade extension mode until a lateral force is exerted on the first lever arm 534. The lateral force may be created by an operating element 46 extending through the eyelet 542, which may pivot or rotate the shift arm 486 in a second direction, as indicated by arrow 566, to overcome the detent 514 and release the lock arm 490 from the extension mode. As previously discussed, the lock arm 490 may be biased toward the engaged position or shade retraction mode and thus, once the lock arm 490 is released from engagement with the shift arm 486, the lock arm 490 may automatically pivot into engagement with the external teeth 474 of the ring gear 294.

Referring now to FIGS. 24A and 24B, one example of the assembled operating system 70 is depicted in cross section. The operating system 70 may be a self-contained, modular unit that is insertable into an end of the roller 42 and may serve as an end cap 26 of the head rail 14. In one implementation, the operating system 70 provides a thin gap between an end of the roller 42 and an associated end of the head rail 14, thereby minimizing a light gap between the shade 22 and the architectural opening when the shade 22 is in an extended position across the opening. In one specific implementation, the distance between the end of the roller 42 and the end of the head rail 14 is about 0.44 inches.

With continued reference to FIGS. 24A and 24B, a fastener 302 may secure the operating system 70 together. The fastener 302 may extend along a central longitudinal axis 570 of the drive mechanism 78 and the transmission 82. As shown in FIGS. 24A and 24B, the fastener 302 may threadably engage the internal wall of the post 114 of the base 74. Additionally or alternatively, a nut, such as a lock nut, may threadably engage the fastener and may be housed within the hollow post 114 of the base 74 of the operating system 70.

In operation, the operating system 70 may be selectively switched into a retraction mode or an extension mode by manipulating the position of the actuator mechanism 86. In one implementation, a user may use the operating element 46 to switch the operating system 70 from a retraction mode into an extension mode. With reference to FIG. 21A, the lock arm 490 is engaged with the ring gear 294 (retraction mode). To disengage the lock arm 490 from the ring gear 294, and thus change the rotation direction of the roller 42, a user may pull the operating element 46 in a direction generally along a longitudinal axis of the roller 42 from a point proximate to an associated end of the roller 42 toward an opposing end of the roller 42. This transverse movement of the operating element 46 pivots or rotates the shift arm 486 about the pivot pin 190 in a first direction 562, moving the first or lower lever arm 534 axially away from the base 74 and the second or upper lever arm 538 axially toward the base 74 (see FIGS. 16A, 16B, 20A, 20B, and 21A). During the rotation of the shift arm 486 in the first direction 562 (see FIG. 16A), a face 550 of the second lever arm 538 contacts a surface 506 of the lock arm 490, thereby pivoting the lock arm 490 radially away from the ring gear 294 to disengage the tooth 518 of the lock arm 490 from the outwardly directed teeth 474 of the ring gear 294.

In one implementation, a user may use the operating element 46 to switch the operating system 70 from an extension mode into a retraction mode. With reference to FIG. 21D, the lock arm 490 is disengaged from the ring gear 294 (extension mode). To engage the lock arm 490 with the ring gear 294, and thus alter the rotation direction of the roller 42, a user may pull the operating element 46 in a vertically downward direction. Since the operating element 46 is routed downward from the operating element conduit 162 of the base 74 through the eyelet 542 of the shift arm 486 (see FIGS. 20A and 20B), upon a vertically downward movement of the operating element 46, the slight axial offset of the eyelet 542 relative to the conduit 162 causes the operating element 46 to move the first or lower lever arm 534 toward the base 74, which in turn moves the second or upper lever arm 538 away from the base 74, which in turn pivots the lock arm **490** radially towards the ring gear **294** into an engaged position (retraction mode). More particularly, the downward movement of the operating element **46** pivots or rotates the shift arm **486** about the pivot pin **190** in a second direction **566**, moving the first or lower lever arm **534** axially toward the base **74** and the second or upper lever arm **538** axially away from the base **74** (see FIGS. **16**A, **16**B, **20**A, **20**B, and **21**A). During rotation of the shift arm **486** in the second direction **566** (see FIG. **16**B), a retaining shoulder **554** and a face **550** of the second lever arm **538** passes by a detent **514** of the lock arm **490**, thereby permitting the lock arm **490** to pivot radially toward the ring gear **294** under the influence of the compression spring **524** (see FIG. **20**C), resulting in the tooth **518** of the lock arm **490** meshing with the outwardly directed teeth **474** of the ring gear **294** (retraction mode, see FIG. **21**A).

When the lock arm **490** is engaged with ring gear **294** (retraction mode), the operating system **70** permits the shade **22** to be raised or retracted. To raise or retract the shade **22**, an operator may pull downward on the operating element **46**. While pulling in a downward direction, the movement of the operating element **46** rotates the spool **194**, which in turn increasingly tensions the spool spring **198**. In addition, the clutch element **274** engages the sun gear **286**, causing the sun gear **286** to rotate along with the spool **194**. As the sun gear **286** rotates, the ring gear **294** is prevented from rotating by the engagement of the lock arm **490** with the outwardly directed teeth **474** of the ring gear **294**. The locked ring gear **294** causes the planet gears **290** to orbit around the sun gear **286**, which in turn causes the planet carrier **298** to rotate. As the planet carrier **298** is coupled to the roller **42**, rotation of the planet carrier **298** rotates the roller **42**, retracting the shade material **22**.

At the end of the downward stroke, the operator releases or resistively raises the operating element **46** and the spool spring **198** correspondingly reels in the operating element **46** around the groove **218** of the spool **194**. As the operating element **46** is retracted, the clutch element isolates the sun gear **286** from the rotation of the spool **194**. Additionally, the operating system **70** prevents the roller **42** from rotating in a shade extension direction, thereby maintaining the position of the shade **22** relative to the architectural opening during the intermittent retraction of the operating element **46**. In one implementation, the sun gear **286** is rotationally locked to the stationary axle **278** in the shade extension direction by at least one wrap spring **282** and the ring gear **294** is rotationally locked by the actuator mechanism **86**. Thus, in this implementation, the sun gear **286** and the ring gear **294** prevent the planet gears **298** from orbiting about the sun gear **286**, thereby prohibiting extension of the shade material **22** across the opening when the operating system **70** is in a retraction mode. Therefore, even though the spool **194** is able to rotate and reel in the operating element **46**, the operating system **70** holds the shade **22** in place. In this fashion, the operator can cyclically pull down on and then retract the cord as many times as necessary to raise or retract the shade material **22** a desired distance, causing the spool **194** to reciprocate rotationally back and forth and the sun gear **286** to incrementally advance forward in a winding direction.

To switch the operating system **70** into an extension mode to extend or lower the shade **22**, the operator may move the operating element **46** in a lateral direction resulting in a diagonal extension of the operating element **46**. This lateral movement may be toward the middle of the shade **22**. The lateral movement of the operating element **46** causes the shift arm **486** to pivot or rotate, with the first or lower lever arm **534** moving away from the base **74** and the second or upper lever arm **538** moving toward the base **74**, which as previously discussed may be an end cap. The biasing face **550** of the shift arm **486** contacts the biasing surface **506** of the lock arm **490**, which in turn causes the lock arm **490** to pivot away from and disengage the ring gear **294**. During this operation, the operator may feel and/or hear a click as the ring gear **294** is released, which may correspond to the biasing face **550** and/or the terminal end **558** of the shift arm **486** surpassing a detent **514** on the lock arm **490**. The amount of operating element **46** motion needed to switch modes of the operating system **70** may be negligible.

Once the lock arm **490** is disengaged from the ring gear **294**, the fixed orientation of the roller **42** may be released, allowing the shade material **22** to unwind and lower by gravity or any other downward biasing element (such as a supplemental spring), for example. The detent **514** associated with the interface of the shift arm **486** and the lock arm **490** maintains the actuator mechanism **86** in the shade extension mode, allowing the operator to release the operating element **46** and no longer monitor the covering **10** as the shade **22** is lowering. Generally, the shade **22** will lower regardless of the operating element **46** handling nuances of the operator, such as holding or releasing the operating element **46**. To stop the extension or lowering of the shade **22**, the operator may shift the operating system **70** into a retraction mode by pulling vertically downward on the operating element **46**, for example. With reference to FIG. **16**B, the downward motion of the operating element **46** pivots or rotates the shift arm **486** about the cross pin **190** in the second direction **566**, as the operating element **46** is routed through the operating element conduit **162**, which resides in the same general vertical plane as the pivot pin **190** (see FIG. **4**A). The roller **42** or operating system **70** may include any suitable speed governing device to regulate the downward speed of the shade **22**.

With reference to FIGS. **25**, **26**A, and **26**B, another example of an operating system **1070** is provided. The operating system **1070** generally has the same features and operation as the operating system **70** previously described with the exception of the clutch element **274** and the actuator mechanism **86**. Accordingly, the preceding discussion of the features and operation of the operating system **70**, as depicted in FIGS. **1-24**, should be considered equally applicable to the operating system **1070** depicted in FIGS. **25**, **26**A, and **26**B, except as noted in the following discussion pertaining to the wrap springs **1282** and the actuator mechanism **1086**. The reference numerals used in FIGS. **25**, **26**A, and **26**B correspond to the reference numbers used in FIGS. **1-24** to reflect the similar parts and components, except the reference numerals have been incremented by one-thousand.

As shown in FIGS. **25** through **26**B, the operating system **1070** may include a transmission **1082** having a sun gear **1286**, a plurality of planet gears **1290**, and an annulus or ring gear **1294**. Similar to the operating system **70** previously discussed, the operating system **1070** includes a wrap spring **1282**A coupled to the sun gear **1286** and having an interference fit between the inner diameter of the wrap spring **1282**A and the outer diameter of the stationary axle **1278**. The wrap spring **1282**A rotationally slips around the axle **1278** in one direction to permit retraction of the shade, but locks around the axle **1278** in the other direction to prevent unwarranted extension of the shade. In contrast to the operating system **70**, the operating system **1070** replaces the clutch element **274** with a second wrap spring **1282**B having an interference fit between the outer diameter of the wrap spring **1282**B and the inner diameter of the sun gear **1286**.

The second wrap spring **1282**B includes a tang **1402** that is coupled to the spool **1194** so that rotation of the spool **1194** in a first, shade retraction direction is transmitted to the sun gear **1286** and rotation of the spool **1194** in a second, shade extension direction is not transmitted to the sun gear **1286**. Thus, similar to the operating system **70** previously discussed, the operating system **1070** selectively transfers torque from the drive mechanism to the transmission in a first direction that retracts the shade but not in a second direction that extends the shade. Further, the operating system **1070** includes a brake element that maintains the shade in a desired position until an operator shifts the operating system **1070** into an extension mode. As shown in FIG. **25**, the operating system **1070** may include an optional cover **1602**, which may be snap-fit onto a proximal side of the base **1074**.

With reference to FIGS. **26**A and **26**B, the operating system **1070** also includes an actuator or shift mechanism **1086**. As shown in FIG. **26**A, the actuator mechanism **1086** is in an extension mode in which the shift arm **1486** has pivoted the lock arm **1490** out of engagement with the outer teeth **1474** of the ring gear **1294**, thereby permitting the shade to extend across an associated architectural opening. A detent **1514** located on the lock arm **1490** holds the shift arm **1486** in the extension mode until a lateral force is applied to the shift arm **1486** through the eyelet, for example. As shown in FIG. **26**B, the actuator mechanism **1086** is in a retraction mode in which an engagement tooth **1518** of the lock arm **1490** is engaged with the external teeth **1474** of the ring gear **1294**, thereby preventing rotation of the ring gear **1294** relative to the base **1074** and preventing extension of the shade. Similar to the actuator mechanism **86** previously discussed, the lock arm **1490** is biased into the engaged position or retraction mode with a biasing element. However, the actuator mechanism **1086** employs an extension spring **1524**, rather than the compression spring **524** discussed in relation to the actuator mechanism **86**. As can be appreciated, any suitable type of biasing element may be used in either example operating system. Although the shape of the shift arm **1486** and the lock arm **1490** are different than the shift arm **486** and the lock arm **490** previously discussed, the shift arm **1486** and the lock arm **1490** generally include the same features and function similarly as the shift arm **486** and the lock arm **490**.

The foregoing description has broad application. For example, while the provided examples include a transmission having a planetary gear set, it should be appreciated that the concepts disclosed herein may equally apply to any type of transmission, regardless of whether the transmission includes a gear reduction. For instance, some transmissions used by the operating system may not include a planetary gear set, such as in applications for small sized window coverings. Thus, it should be appreciated that the actuator mechanism may engage any type of transmission device. Further, the input and output components of the planetary gear set may vary depending on the window covering application. Moreover, although wrap springs and one type of clutch element have been discussed, other suitable brake and/or clutch elements may be used. Additionally, the example operating system may be used with any type of shade, including, but not limited to, roller and stackable shades. Furthermore, the example operating module or system may be used in association with either end of a head rail. For example, although the illustrated operating module may be configured for association with a right-hand side of a covering, an operating module configured for association with a left-hand side of the covering may be provided and may be a mirror image of the illustrated module. Accordingly, the discussion of any embodiment is meant only to be explanatory and is not intended to suggest that the scope of the disclosure, including the claims, is limited to these examples. In other words, while illustrative embodiments of the disclosure have been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed, and that the appended claims are intended to be construed to include such variations, except as limited by the prior art.

The foregoing discussion has been presented for purposes of illustration and description and is not intended to limit the disclosure to the form or forms disclosed herein. For example, various features of the disclosure are grouped together in one or more aspects, embodiments, or configurations for the purpose of streamlining the disclosure. However, it should be understood that various features of the certain aspects, embodiments, or configurations of the disclosure may be combined in alternate aspects, embodiments, or configurations. Moreover, the following claims are hereby incorporated into this Detailed Description by this reference, with each claim standing on its own as a separate embodiment of the present disclosure.

The phrases "at least one", "one or more", and "and/or", as used herein, are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions "at least one of A, B and C", "at least one of A, B, or C", "one or more of A, B, and C", "one or more of A, B, or C" and "A, B, and/or C" means A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B and C together.

The term "a" or "an" entity, as used herein, refers to one or more of that entity. As such, the terms "a" (or "an"), "one or more" and "at least one" can be used interchangeably herein.

The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Accordingly, the terms "including," "comprising," or "having" and variations thereof are open-ended expressions and can be used interchangeably herein.

All directional references (e.g., proximal, distal, upper, lower, upward, downward, left, right, lateral, longitudinal, front, back, top, bottom, above, below, vertical, horizontal, radial, axial, clockwise, and counterclockwise) are only used for identification purposes to aid the reader's understanding of the present disclosure, and do not create limitations, particularly as to the position, orientation, or use of this disclosure. Connection references (e.g., attached, coupled, connected, and joined) are to be construed broadly and may include intermediate members between a collection of elements and relative movement between elements unless otherwise indicated. As such, connection references do not necessarily infer that two elements are directly connected and in fixed relation to each other. Identification references (e.g., primary, secondary, first, second, third, fourth, etc.) are not intended to connote importance or priority, but are used to distinguish one feature from another. The drawings are for purposes of illustration only and the dimensions, positions, order and relative sizes reflected in the drawings attached hereto may vary.

I claim:

1. An operating system for use with a covering, the covering including a roller and a shade, the shade being movable between an extension direction and a retraction direction, the operating system being operably associated with the roller, the operating system comprising:

an operating element arranged and configured to provide an input torque for selectively rotating the roller to move the shade in the retraction direction;

a transmission arranged and configured to selectively transmit the input torque to the roller; and

an actuator mechanism operatively associated with the operating element and the transmission, the actuator mechanism being pivotably moveable between a first position and a second position;

wherein:

the operating system includes a retraction mode and an extension mode, in the retraction mode, the operating system is operable to raise the shade in the retraction direction, and in the extension mode, the operating system is operable to lower the shade in the extension direction;

movement of the actuator mechanism between the first and second positions switches the operating system between the retraction and extension modes, respectively; and

in the extension mode, the operating system is arranged and configured to enable the shade to move in the extension direction automatically under an influence of gravity without further action by an operator;

wherein the actuator mechanism includes a first arm and a second arm, the second arm being configured to slidably contact the first arm to move the first arm, the first arm selectively engages with the transmission to set a rotation direction of the roller, the second arm operably associated with the first arm to move the first arm into and out of engagement with the transmission; and

wherein the second arm is movable about a first axis that is generally transverse to a longitudinal axis of the roller, and the first arm is movable about a second axis that is generally transverse to the first axis.

2. The operating system of claim **1**, wherein movement of the operating element in a predetermined direction moves the actuator mechanism between the first and second positions.

3. The operating system of claim **2**, wherein a downward motion of the operating element shifts the actuator mechanism to the first position.

4. The operating system of claim **3**, wherein a lateral motion of the operating element shifts the actuator mechanism to the second position.

5. The operating system of claim **1**, wherein in the retraction mode, the operating element is moveable by an operator in a series of reciprocating strokes to raise the shade in the retraction direction.

6. The operating system of claim **5**, further comprising a brake mechanism, wherein, in the retraction mode, the brake mechanism is arranged and configured to prevent the shade from lowering in the extension direction.

7. The operating system of claim **1**, wherein moving the second arm causes the first arm to disengage from the transmission.

8. A covering for an architectural opening, comprising:

a rotatable roller rotatable about a longitudinal axis in an extension direction and a retraction direction;

a shade associated with the roller; and

an operating system operably associated with the roller, the operating system comprising;

a base;

a drive mechanism associated with the base to provide an input torque;

a transmission associated with the drive mechanism to selectively transmit the input torque to the roller;

an engagement arm operably associated with the base; and

an actuator arm operably associated with the base, the actuator arm arranged and configured to set a rotation direction of the roller, the actuator arm movable about a first axis generally transverse to the longitudinal axis of the roller;

wherein the engagement arm is movable about a second axis and selectively engages the transmission to set the rotation direction of the roller.

9. The covering of claim **8**, wherein the second axis is one or both of generally parallel to the longitudinal axis of the roller, and generally transverse to the first axis.

10. The covering of claim **8**, wherein the transmission includes a ring gear, and wherein the engagement arm selectively engages the ring gear to set the rotation direction of the roller.

11. The covering of claim **8**, wherein the operating system further comprises a biasing element configured to bias the engagement arm into engagement with the transmission.

12. The covering of claim **8**, wherein to set the rotation direction of the roller to the extension direction, the actuator arm contacts the engagement arm to disengage the engagement arm from the transmission, wherein the engagement arm includes a detent configured to retain the actuator arm in a position associated with the extension direction.

13. The covering of claim **8**, wherein when the engagement arm sets the rotation direction of the roller to an extension direction, the shade extends without further action by an operator.

14. The covering of claim **8**, wherein the drive mechanism includes a single operating element, the single operating element operably associated with the actuator arm so that select movement of the single operating element moves the actuator arm.

15. The covering of claim **8**, wherein when the actuator arm sets the rotation direction of the roller to the extension direction, the shade extends automatically under the influence of gravity without further action by an operator.

16. The covering of claim **8**, wherein the actuator arm is positioned relative to the transmission so that the actuator arm does not engage the transmission.

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